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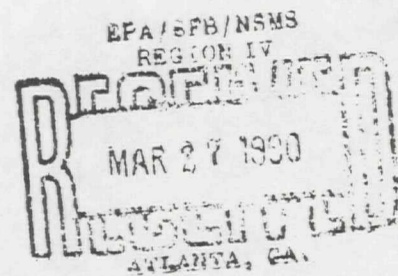
FEASIBILITY STUDY REPORT
SCRDI-BLUFF ROAD SITE
COLUMBIA, SOUTH CAROLINA

VOLUME II-APPENDICES

DRAFT

Prepared for:

The Bluff Road Group

March 1990

SCRDI BLUFF ROAD SITE
NPL SITE ADMINISTRATIVE RECORD

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APPENDIX A

SOIL-WATER PARTITIONING MODEL

Soil - Water Partioning Model

Description and Results

The results of the Remedial Investigation and more specifically the Risk Assessment indicate that the Bluff Road Site does not currently pose an elevated threat to human health or the environment. However. data indicate that for the hypothetical future use scenario, there appear to be concentrations of site related contaminants in the shallow aquifer that may result in elevated levels of exposure only if the health protective assumptions of the potential future use scenario are realized. Table A-1 provides a list of contaminants and appropriate cleanup criteria which would represent the worst case concentrations for a ground water treatment system design under the potential future use scenario. These are the most mobile contaminants that were present on-site in the shallow aquifer and shallow soils.

The method used to identify appropriate cleanup criteria for the contaminants of concern in soil which may leach to ground water is described below. This approach for estimating soil cleanup levels is highly conservative in that is considers vertical mixing as the sole attenuative process in ground water transport. The operation of the other attenuative processes may be inferred from the absence of other contaminants in ground water samples analyzed during the RI. The model assumes that a percentage of rainfall at the site will infiltrate and desorb contaminants from the soil based on soil-water partioning. It is further assumed that this contaminated infiltrate will mix completely with a portion of ground water from the site, resulting in a equilibrium ground water concentration.

To back calculate theoretical soil concentrations. the rate of mixing of infiltration with ground water is first estimated. Starting with the concentrations provided in Table A-1 as the acceptable contaminant concentrations in ground water, the mixing is used to back calculate contaminant concentrations in the infiltrate. These concentrations can be related to soil concentrations using the soil-water equilibrium relationship. According to the model, the mixing of ground water and infiltration, and the resultant contaminant concentrations in ground water are related as follows (Summers et al., 1980)

$$Cgw = (Qp)(Cp)/Qp+Qgw$$ Equation 1

The contaminant concentrations in ground water (Cgw) are the acceptable contaminant concentrations in ground water (Table A-1) The volumetric flow rate of infiltration (Qp) is determined by subtracting potential evapotranspiration (36 inches/year) from the total rainfall (45 inches/year) occurring over the total area of contaminated soil (Section 1.4).

A conservative simple source geometry of 250 ft parallel to the average ground water flow direction by 125 ft perpendicular to the average ground water flow direction is assumed. This gives a contaminated soil source area of 31,250 sq. ft. and a value for Qp of 62.5 cubic feet/ day.

The volumetric flow rate of ground water (Qgw) is estimated to be 42 cubic feet/day. It is estimated as the specific discharge times the effective vertical cross-sectional area of the aquifer perpendicular to the ground water flow across the contaminated area of the site.

$$Qgw = KiA \qquad\qquad \text{Equation 2}$$

For this an aquifer thickness of 40 ft was assumed to be representative. The hydraulic conductivity (K) was assumed to be 2.8 ft/day the more conservative value of the range reported in the RI. The hydraulic gradient was taken to be 0.002, the average of the range reported in the RI. The cross-sectional area of ground water flow (A) is equal to the width of the source area (125 ft) perpendicular to ground water flow, multiplied by the depth (40 ft) into the aquifer in which mixing occurs.

With values of Cgw, Qp, and Qgw, equation 1 can be rearranged to solve for the acceptable contaminant concentration (Cp) in the infiltration.

$$Cp = Cgw(Qp + Qgw)/Qp \qquad\qquad \text{Equation 3}$$

The soil water partioning model is expressed as:

$$Cs = (Cp)(Koc)(foc) \qquad\qquad \text{Equation 4}$$

where: Koc = Organic carbon partition coefficient (l/kg)

foc = Fraction organic carbon

Cs = Contaminant concentration in soil (mg/K)

4 9   0230

The value of foc was assumed to be 0.02, the average as reported by the USDA Soil Conservation Service (verbal communication, Stuckey, 1990).

Where values of Koc were not available, Kd was calculated based on the following equation (Walton, 1984).

$$Kd = 0.63(foc)(Kow)_i$$ Equation 5

Kd = distribution coefficient (ml/g)

Kow = octanol water partition coefficient

i = solute index

With a value for Kd, Cs can then be calculated based on the following equation

$$Cs = Kd(Cp)$$ Equation 6

The target cleanup level (TCL) is equal to Cs or the Cgw, whichever is greater. Values for all terms are provided in Table A-1.

Table
Calculation of Soil Target Cleanup Levels
Soil-Water Partioning Theory Model

Constituent	Cgw	Qp	Cp	Qgw	L	W	R	E	K	h	D	Koc	foc	Cs	TCL
Acetone	1.100	62.5	1.593	28	125	250	0.01	0.008	2.8	0.002	40	2.2	0.02	0.070	1.100
Benzene	0.005	62.5	0.007	28	125	250	0.01	0.008	2.8	0.002	40	83	0.02	0.012	0.012
Carbon Tetrachloride	0.005	62.5	0.007	28	125	250	0.01	0.008	2.8	0.002	40	363	0.02	0.053	0.053
Chlorobenzene	0.100	62.5	0.145	28	125	250	0.01	0.008	2.8	0.002	40	330	0.02	0.956	0.956
Chloroform	0.021	62.5	0.030	28	125	250	0.01	0.008	2.8	0.002	40	31	0.02	0.019	0.021
2-Chlorophenol	0.550	62.5	0.796	28	125	250	0.01	0.008	2.8	0.002	40		0.02	0.460	0.550
1,1-Dichloroethane	0.005	62.5	0.007	28	125	250	0.01	0.008	2.8	0.002	40		0.02	0.006	0.006
1,2-Dichloroethane	0.005	62.5	0.007	28	125	250	0.01	0.008	2.8	0.002	40	32	0.02	0.005	0.005
1,2-Dichloroethene	0.070	62.5	0.101	28	125	250	0.01	0.008	2.8	0.002	40	59	0.02	0.120	0.120
1,1-Dichloroethene	0.007	62.5	0.010	28	125	250	0.01	0.008	2.8	0.002	40	65	0.02	0.013	0.013
Ethyl Benzene	0.700	62.5	1.014	28	125	250	0.01	0.008	2.8	0.002	40	1100	0.02	22.299	22.299
Methylene Chloride	0.017	62.5	0.025	28	125	250	0.01	0.008	2.8	0.002	40	8.8	0.02	0.004	0.017
2-Butanone	0.055	62.5	0.080	28	125	250	0.01	0.008	2.8	0.002	40	4.5	0.02	0.007	0.055
4-Methyl-2-Pentanone	0.550	62.5	0.796	28	125	250	0.01	0.008	2.8	0.002	40	NA	0.02	NA	0.550
Phenol	1.500	62.5	2.172	28	125	250	0.01	0.008	2.8	0.002	40	91	0.02	3.953	3.953
1,1,2,2 Tetrachloroethane	0.0006	62.5	0.001	28	125	250	0.01	0.008	2.8	0.002	40	79	0.02	0.001	0.001
1,1,1 Trichloroethane	0.200	62.5	0.290	28	125	250	0.01	0.008	2.8	0.002	40	178	0.02	1.031	1.031
1,1,2 Trichlrorethane	0.002	62.5	0.003	28	125	250	0.01	0.008	2.8	0.002	40		0.02	0.007	0.007
Tetrachloroethene	0.005	62.5	0.007	28	125	250	0.01	0.008	2.8	0.002	40	364	0.02	0.053	0.053
Trichloroethene	0.005	62.5	0.007	28	125	250	0.01	0.008	2.8	0.002	40	126	0.02	0.018	0.018
Toluene	2.000	62.5	2.896	28	125	250	0.01	0.008	2.8	0.002	40	300	0.02	17.376	17.376
Vinyl Chloride	0.002	62.5	0.003	28	125	250	0.01	0.008	2.8	0.002	40	57	0.02	0.003	0.003
Xylenes	10.000	62.5	14.480	28	125	250	0.01	0.008	2.8	0.002	40	240	0.02	69.504	69.504

Cgw - contaminant concentration in ground water (ug/l)
Qp - volumetric flow rate of infiltration into ground water(cu.ft/day)
Qgw - volumetric flow rate of ground water (cu.ft/day)
Cp - contaminant concentrations in the infiltration
K - hydraulic conductivity (ft/day)
h - hydraulic gradient (ft/ft)
L - length of aquifer perpendicular to flow
TCL -Target Cleanup Level

D - depth of aquifer
Cs - soil concentrations (mg/kg)
Cp - concentrations in the infiltration (ug/liter)
Kd - an equilibrium partition coefficient (ml/g)
R - average annual rainfall (ft./day)
E - average annual evapotranspiration (ft./day)

* Where values of Koc are not provided, the equation utilizing Kd
was applied. However, a Kd value was not available
for 4-methyl-2-pentanone so the MCL has been used as the TCL.

APPENDIX B

POST-REMEDIATION GROUND WATER
PUBLIC HEALTH EVALUATION

POST-REMEDIATION GROUND WATER

PUBLIC HEALTH EVALUATION

The baseline risk assessment portion of the RI report prepared by IT Corporation concluded that current levels of ground water contamination at the Bluff Road site posed no risk to public health under current conditions. However, if future conditions at the site involved use of the shallow aquifer as a drinking water supply, current levels of contamination might pose a health risk. The ground water target cleanup levels listed in Table 3-2 were developed to mitigate this risk. The purpose of this section is to evaluate the effectiveness of these target cleanup levels in reducing potential health risks.

1.   Exposure Assessment

As discussed previously, ground water at the site is not currently used as a potable water source. Considering the possibility that it might be used as such a supply in the future, however, one can evaluate potential levels of human exposure to levels of ground-water contaminants at post-remediation levels.

For the sake of consistency, potential human exposure to ground water is evaluated in this section in the same manner in which some of the target cleanup levels were derived. The most likely receptor for exposure via this pathway is a resident living near the site who uses ground water as his potable water supply. Assumptions that are used to quantify exposure levels are presented in Table 1. These calculations are based on a 70 kg adult

who consumes 2 liters of water per day. However, a 64% 'occupancy factor' is applied to this value to reflect the fact that an individual would not spend all of his time at home and thus would not receive all of his daily water intake from on-site ground water. This consideration is reflected in the 1.28 liters/day water consumption factor listed in Table 1. In addition, it is assumed that an individual might be exposed via this pathway for 30 years of his lifetime, which is the national upper bound (90th percentile) of time a person is likely to spend at one residence (1). In other words, it is assumed that an individual would not live his entire life at one residence. Other assumptions presented in Table 1 are consistent with standard USEPA exposure parameters.

The values listed in Table 1 are used to calculate estimated exposure dosages with the following formula.

$$OEX = \frac{CW \times IR \times EF \times ED}{BW \quad LT}$$

Where:

OEX = oral exposure dosage from drinking water (mg/kg/day)

CW = contaminant concentration in drinking water (mg/l)

= ground water target cleanup level (Table 3-2) in this case

IR = drinking water ingestion rate (l/day)

EF = exposure frequency (days/year) = 365

ED = exposure duration (years)

BW = body weight (kg)

LT = average human lifetime (days) = 25600

Table 2 presents ground water target cleanup levels and corresponding estimated drinking water exposure dosages calculated using the above equation.

2.   Toxicity Assessment

Human health criteria for oral exposure to the chemicals of interest are presented in Table 2. These values were obtained from USEPA Health Effects Assessment Summary Tables (2), with the exception of values for copper, iron, and lead. The values for copper and lead were presented in the 1986 Superfund Public Health Evaluation Manual (3), but have been withdrawn in more recent documents. They are presented in this table to allow for some quantification of risks associated with these compounds. However, the fact that these values are no longer recommended should be recognized as an area of uncertainty in this assessment. In addition, no toxicity criteria for iron were identified, and this should also be regarded as an area of uncertainty.

For compounds which are considered potential carcinogens, a cancer potency factor (CPF) is presented. The CPF is expressed in units of inverse dosage, i.e. $(mg/kg/day)^{-1}$. Simply stated, it represents the increase in risk of cancer mortality per unit of exposure dosage. In most cases, CPFs are derived using data from animal experiments and applying a low-dose extrapolation model and incorporating conservative assumptions concerning interspecies extrapolation.

For compounds not regarded as potential carcinogens, a reference dose (RfD), also called an acceptable intake for chronic exposure (AIC), is provided. This value represents the exposure dosage in mg/kg/day which, if consumed daily throughout a person's lifetime, would not result in any adverse health effects. USEPA usually derives RfDs based on animal data which define a no-effect dosage or threshold for toxicity. This threshold value is divided by a conservative safety factor, typically 100 or 1000, to derive a human RfD. These RfD values may then be used to determine a hazard index (HI) for given exposures. The HI is the ratio of the estimated exposure level to the RfD value. HI values greater than 1.0 may indicate a potential health risk.

The approach used to characterize risk in this section is analogous to the methods used in the baseline RI risk assessment (IT Corporation, 1989).

3.   Risk Characterization

This section describes the potential health risks associated with estimated exposure levels calculated as described previously. Risk estimates for potential carcinogenic and non-carcinogenic effects are presented in Table 2.

As shown in Table 2, the total incremental lifetime cancer risk associated with exposure to all chemicals of concern under the conditions of this scenario is 1.5E-05.

The overall HI for non-carcinogenic effects is 1.7E+0.

4.   References

(1)   USEPA.   1989.   Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual.   EPA/540/1-89/002.

(2)   USEPA.   1989.   Health Effects Assessment Summary Tables.   OERR 9200.6-303-(89-2).

(3)   USEPA. 1986.   Superfund Public Health Evaluation Manual.   EPA 540/1-86/060.

TABLE   1

EXPOSURE SCENARIO FOR FUTURE GROUND WATER USERS
INGESTION OF GROUND WATER
USING TARGET CLEANUP LEVELS

Receptors:	Future ground water users
Adult or Child:	Adult
Male/Female:	Both Male and Female
Frequency of Exposure:	365 days/year
Duration of Exposure:	30 years
Drinking Water Consumption Rate	1.28 L/day
Body Weight	70 kg (USEPA, 1989)

Potential Exposure Pathways Considered Significant:

Ingestion of Ground Water

Compounds:	All site-specific chemicals
Data Sets:	Ground water target cleanup levels.

TABLE 2

RISK CALCULATIONS FOR RESIDENT EXPOSURE
INGESTION OF DRINKING WATER
USING TARGET CLEANUP LEVELS

Chemical	Maximum Concent. (mg/1)	Oral Exposure Dosage (mg/kg/day)$^{-1}$	Oral CPF (mg/kg/day)$^{-1}$	Oral RFD (mg/kg/day)	Risk	Hazard Index
Volatiles:						
Acetone	1.1E+00	8.6E-03		1.0E-01		8.6E-02
Chloroform	2.1E-02	1.6E-04	6.1E-03	1.0E-02	1.0E-06	1.6E-02
1,1,1-Trichloroethane	2.0E-01	1.6E-03		9.0E-02		1.7E-02
Methylene Chloride	1.7E-02	1.3E-04		6.0E-02		2.2E-03
1,1-Dichloroethane	5.0E-03	3.9E-05		1.0E-01		3.9E-04
2-Butanone	5.5E-01	4.3E-03		5.0E-02		8.6E-02
Trichloroethene	5.0E-03	3.9E-05	1.1E-02		4.3E-07	
1,1,2,2-Tetrachloroethane	6.0E-04	4.7E-06	2.0E-01		9.4E-07	
Ethylbenzene	7.0E-01	5.5E-03		1.0E-01		5.5E-02
Toluene	2.0E+00	1.6E-02		3.0E-01		5.2E-02
Chlorobenzene	1.0E-01	7.8E-04		3.0E-02		2.6E-02
Tetrachloroethene	5.0E-03	3.9E-05	5.1E-03	1.0E-02	2.0E-07	3.9E-03
1,2-Dichloroethene	7.0E-02	5.5E-04				
Xylenes	1.0E+01	7.8E-02		2.0E+00		3.9E-02
1,1-Dichloroethene	7.0E-03	5.5E-05		9.0E-03		6.1E-03
Benzene	5.0E-03	3.9E-05	2.9E-02		1.1E-06	
1,2-Dichloroethane	5.0E-03	3.9E-05	9.1E-02		3.6E-06	
Carbon Tetrachloride	5.0E-03	3.9E-05	1.3E-01	7.0E-04	5.1E-06	5.6E-02
1,2-Dichloropropane	5.0E-03	3.9E-05	6.8E-02		2.7E-06	
2-Chlorophenol	5.5E-02	4.3E-04		5.0E-03		8.6E-02
4-Methyl-2-Pentanone	5.5E-01	4.3E-03		5.0E-02		8.6E-02
1,1,2-Trichloroethane	2.2E-03	1.7E-05	5.7E-03	4.0E-03	9.8E-08	4.3E-03

TABLE 2 (Cont'd.)

Chemical	Maximum Concent. (mg/1)	Oral Exposure Dosage (mg/kg/day) [1]	Oral CPF (mg/kg/day) [1]	Oral RFD (mg/kg/day)	Risk	Hazard Index
Metals:						
Arsenic	5.0E-02	3.9E-04				
Barium	1.0E+00	7.8E-03		5.0E-02		1.6E-01
Cadmium	5.0E-03	3.9E-05		5.0E-04		7.8E-02
Chromium III	5.0E-02	3.9E-04		1.0E+00		3.9E-04
Chromium VI	5.0E-02	3.9E-04		5.0E-03		7.8E-02
Copper	1.0E+00	7.8E-03		3.7E-02		2.1E-01
Iron	3.0E-01	2.3E-03				
Lead	5.0E-02	3.9E-04		1.4E-03		2.8E-01
Manganese	5.0E-02	3.9E-04		1.0E-02		3.9E-02
Mercury	2.0E-03	1.6E-05		3.0E-04		5.2E-02
Selenium	1.0E-02	7.8E-05		3.0E-03		2.6E-02
Zinc	5.0E+00	3.9E-02		2.0E-01		2.0E-01
				TOTAL:	1.5E-05	1.7E+00

APPENDIX C

**AIR QUALITY IMPACT ANALYSIS AND PUBLIC
HEALTH EVALUATIONS FOR TREATMENT OF
GROUND WATER USING AIR STRIPPING**

AIR QUALITY IMPACT ANALYSIS AND PUBLIC HEALTH EVALUATION FOR TREATMENT OF GROUND WATER USING AIR STRIPPING AT THE SCRDI BLUFF ROAD SITE

An evaluation to assess the health effects associated with air emissions from the on-site treatment of ground water using air stripping at the SCRDI Bluff Road site is presented in this document. Air quality dispersion modeling was performed to predict maximum ambient air impacts to support this evaluation. Long-term modeling was conducted to determine maximum annual impacts using 5 years of regional National Weather Service (NWS) meteorological data. Short-term impacts were evaluated using a screening model to estimate the maximum 1-hour concentrations based on a worst-case combination of atmospheric stability and wind speed.

Section 1 discusses the dispersion modeling techniques employed. Section 2 presents the input data used. Section 3 describes the procedure for modeling receptor selection. Section 4 presents the dispersion modeling results. Section 5 presents the public health evaluation.

1.   Dispersion Modeling Techniques

Both screening and refined modeling were conducted as part of the air quality dispersion analysis. For short-term impacts (24 hours or less), the United States Environmental Protection Agency (USEPA) recommends use of a screening model to estimate conservative short-term impacts for pollutants released from a stationary source.[1] If, based on appropriate screening techniques, the concentration of a pollutant is predicted below an acceptable

health-based level, no further modeling of the pollutant is required due to the conservative nature of the prediction. If, on the other hand, the predicted concentration is above this acceptable health-based level, a refined modeling analysis is necessary to predict the short-term maximum concentration.

USEPA recommendations contained in Guideline on Air Quality Models (Revised)[2] were used to select the appropriate dispersion models. Three factors were considered:

a. Whether the area is classified as urban or non-urban according to USEPA modeling protocols;

b. Whether it is necessary to consider plume impact upon complex terrain; and

c. Whether it is necessary to consider building-induced aerodynamic downwash effects.

Figure 1 presents a site location map depicting the site boundary and surrounding area. The area surrounding the site is non-urban based on recommended USEPA classification procedures. The recommended method is to apply the Auer Classification Scheme[3] to classify land use patterns within 3 km of a site. United States Geological Survey (USGS) topographic maps for the site and vicinity clearly indicate that the area is non-urban; therefore modeling was conducted in the non-urban or rural mode.

The proposed stack height and results of the screening modeling are used to determine whether plume impact upon complex terrain need be considered. Preliminary screening modeling results based on a proposed stack height of 30 feet indicated that maximum impacts (discussed further in Section 4) would occur well within 2.0 km of the source. The area surrounding the site (within 2.0 km) has terrain elevations ranging from 25 feet above to 22 feet below stack base elevation. In accordance with USEPA guidance,[2] it is not necessary to consider plume impact upon terrain; therefore, a simple terrain model was used.

Finally, as designed, the air stripping system will achieve a Good Engineering Practice (GEP) stack height based on nearby and/or adjacent building geometry.[4] As such, it was not necessary to model aerodynamic building-induced downwash effects.

Based on the above considerations, the Industrial Source Complex Long-Term (ISCLT) model was used to predict annual concentrations, and the Point-Plume-2 (PTPLU-2) model was used to predict maximum 1-hour concentrations. Results using the PTPLU-2 model were also employed to select receptors for use in modeling with ISCLT model. Options used in ISCLT and PTPLU-2 are consistent with USEPA guidance.[2] For both models, the options selected included the adjustment of the stack height for stack tip downwash, determination of final plume rise for all downwind receptor locations, and use of rural-mode wind profile coefficients. Because the air stripping system exhaust gas will be emitted at ambient temperature, plume enhancement due to buoyancy effects did not require consideration.

2. Input Data Used

The dispersion modeling analysis to evaluate air quality impacts from on-site air stripping required development and input of a detailed emissions inventory, and assembly and input of representative meteorological data. Each of these two areas is discussed below.

2.1 Emissions Inventory

Table 1 presents stack emission rates and associated input data. Table 2 presents preliminary design stack parameters. Based on vendor input information, the proposed design capacity of the air stripping system is 100 gallons per minute (gpm). To estimate potential emission rates, it is conservatively assumed that 100 percent of the organics would be stripped from the ground water and would enter into the vapor phase. Control of contaminants entering the vapor phase would be by means of granular activated carbon filtration. The design control efficiency of this air pollution control (APC) system is greater than 99.9 percent.

The concentrations of contaminants in the ground water to be treated are based on concentrations detected in the monitoring wells located within the plume of contaminated ground water. Average concentrations were calculated for each contaminant detected and are presented in Table 1 as 'stripper inlet concentrations'.

Based on the above assumptions, Table 1 presents emission rates both with and without controls. Contaminant impacts upon ambient air quality were predicted for this APC system.

2.2 Meteorological Data

Representative meteorology was used in the screening modeling using PTPLU-2 and refined modeling using ISCLT.

Table 3 presents the meteorological conditions used for the PTPLU-2 screening analysis. PTPLU-2 predicts the maximum downwind concentrations based on discrete combinations of stability class and wind speed, and does not require actual meteorology representative of the source location.

The ISCLT model employed 5 years of annual stability array (STAR) data based on hourly observations from the NWS station in Columbia, South Carolina. The data provides annual joint frequencies of stability versus wind speed and wind direction. The period of record employed was the years 1982 through 1986. Annual modeling was conducted separately for each of the 5 years of meteorological data.

3. Modeling Receptor Selection

Receptors were identified to ensure selection of downwind locations at which the highest concentrations would occur for both 1-hour concentrations predicted using PTPLU-2 and annual concentrations predicted using ISCLT.

3.1 PTPLU-2 Receptors

Because PTPLU-2 does not use actual meteorology, locations of the highest predicted concentrations are determined as relative distances from the source based on discrete wind speed and stability combinations (refer to Table 3). Predictions are first made at fixed distances downwind of the source. Then, from the location at which the highest downwind concentration is predicted, the distance to the maximum concentration is incrementally searched for and located to the nearest 1 meter.

3.2 ISCLT Receptors

The ISCLT receptor grid consisted of a polar coordinate grid and additional receptors located on the site property/fenceline. A total of 408 receptors were used in ISCLT modeling.

The polar coordinate receptor grid was based on the PTPLU-2 screening results. The PTPLU-2 analysis using the input stack parameters presented in Table 2 identified distances to potential high-impact receptors as a function of the stability class/wind speed combinations

presented in Table 3. Receptor ring distances of 0.060, 0.090, 0.120, 0.160, 0.190, 0.230, 0.285, 0.500, 1.000, 1.500, and 2.000 km were selected.

Each of the above 11 polar coordinate rings was divided into 10-degree sectors, yielding a total of 36 receptors per ring. Variation in terrain within the vicinity of each receptor was accounted for by using the highest terrain elevation in a nearly rectangular area surrounding that receptor. The area was bounded on either side by an arc length which was plus or minus 5 degrees of the actual receptor location. The top and bottom of the rectangular area was bounded by half the distance to the preceding and following polar receptor rings.

Table 4 identifies 12 additional discrete fenceline modeling receptor locations surrounding the proposed location of the air stripping system stack. These additional receptors were selected to provide an added measure of confidence that the area of greatest impact would be identified.

4.   Dispersion Modeling Results

Table 5 presents the maximum predicted 1-hour and annual concentrations for each contaminant listed in Table 1. The distance to the receptor predicted to have the maximum 1-hour concentration, based on PTPLU-2 modeling, is 114m from the source. The location at which the maximum annual predicted concentration occurs, based on ISCLT modeling, is located 200° (south-southwest) from the source at a distance of 120m.

5.   Public Health Evaluation

Based on the modeling results, a public health evaluation (PHE) may be performed for the receptor groups which are likely to experience maximum exposures to airborne emissions from the air stripper system. The modeling results identified the downwind distance where maximum 1-hour concentrations would be expected, and the location where maximum annual concentrations would be expected. This PHE identifies the likely receptors associated with those locations, formulates worst-case exposure scenarios for the most-exposed receptors, and quantitatively estimates exposure levels and associated health risks for those exposure pathways.

5.1 Receptors

Based on the location where maximum short- and long-term air contaminant concentrations are predicted to occur, it is possible to identify two receptor groups which may experience maximum exposures to airborne contaminants. These groups are: (1) remediation workers in the immediate vicinity of the emissions source (i.e., air stripping system) who would be the closest receptors and who might be exposed to short-term peak concentrations; and (2) off-site residents who might be exposed to lower concentrations for longer periods. To represent the first group, it is assumed that the most-exposed individual (MEI) would be an adult worker. The MEI for the second group is identified as a child who lives in the vicinity of the site. The child is used because

of his higher inhalation rate to body weight ratio, thus resulting in a maximum (worst-case) exposure dosage estimate. Selection of a child is also related to the possibility that he might play in the area of the site, even though there are no residences in the immediate vicinity. (The nearest residence is over 1 mile away.) Because the air stripper is expected to operate for 16 years, this child would be exposed for an extended period. For the purpose of this calculation, it is assumed that a child would be exposed for 16 years beginning at age 6. It was felt that younger children would not be likely to travel the distances necessary to get near the site. The use of the child therefore provides a worst-case estimate of exposure.

5.2 Exposure Assessment

Table 6 presents Threshold Limit Values (TLVs) for each contaminant of concern, and compares the values to maximum predicted 1-hour concentrations. TLVs were developed by the American Conference of Governmental and Industrial Hygienists (ACGIH), [6] and are occupational exposure criteria that represent airborne concentrations of substances to which nearly all workers may be repeatedly exposed without adverse effects. TLVs presented in Table 6 represent time-weighted average (TWA) concentrations to which individuals may be exposed during a normal 8-hour workday and 40-hour workweek without experiencing any adverse health effects. TLVs are based on the best available information from industrial experience, as well as data from human and animal studies. TLVs are used in industrial hygiene practice to control potential

health hazards for workers. TLVs are issued by the ACGIH, and are guidelines rather than enforceable standards.

Because the maximum predicted 1-hour concentrations are far below TLVs for long-term occupational exposure, it is concluded that there is no danger of acute toxicity due to exposure to short-term peak emissions from the air stripping system. The remainder of the PHE will, therefore, address only the potential for long-term health effects.

Table 7 presents assumptions used in the worker exposure scenario. As discussed previously, it is assumed that this worker is an adult male involved in work at the site. The period of exposure is estimated to be 16 years, i.e., the time during which the air stripping system is expected to be operating. An inhalation rate of 2.8 m^3/hour, corresponding to an adult male involved in moderate activity, [7] is used.

The assumptions listed in Table 7 are incorporated to calculate exposure dosages using the following equation:

$$IEX = AC \times IR \times D \times (1/1,000) \div BW \times EP \div 25,600$$

Where:

IEX	=	inhalation exposure dosage (mg/kg/day)
AC	=	airborne contaminant concentration (ug/m^3)
IR	=	inhalation rate (m^3/hour)

D   =   duration of daily exposure (hours/day)

1/1,000   =   conversion factor (mg/ug)

BW   =   body weight (kg)

EP   =   exposure period (days)

25,600   =   length of human lifetime (days)

Maximum annual average contaminant concentrations from Table 5 are used in this calculation as AC values to provide worst-case estimates of long-term exposure levels.

Table 8 presents assumptions used in the exposure scenario involving the child. These assumptions are the same as used in the first scenario with the following exceptions. Because the receptor is a child, a different body weight and inhalation rate are used. Because the exposure period is extended over various life stages, time-weighted average values for the parameters are used in the calculations. The inhalation rate (2.7 m³/hour) presented in Table 8 represents a time-weighted average of inhalation rates for 6-year olds, 10-year olds, and adults involved in moderate activity as presented in the USEPA Superfund Exposure Assessment Manual [7]. The assumed body weight for this receptor (50 kg) is a time-weighted average of body weights for males within various age groups (from age 6 to 21) listed in the USEPA Exposure Factors Handbook. [8] In addition, the duration of an exposure period is assumed to be 4 hours/day rather than 8 hours/day. This value represents a reasonable worst-case average because it is not likely that children or young adults would engage in activities near the

site for extended periods due to the fact that the nearest residence is more than 1 mile away. The 4 hour/day value represents a reasonable worst-case average for children playing near the site or young adults involved in other activities (e.g., hunting) near the site.

The same equation used previously is again used to calculate exposure estimates. Once again, maximum annual average contaminant concentrations from Table 5 are used in this calculation as AC values to provide worst-case estimates of long-term exposure levels.

5.3   Toxicity Assessment

Table 9 and 10 present human health criteria for inhalation exposure to the contaminants of interest. These values were obtained from USEPA Health Effects Assessment Summary Tables. [9] For those contaminants that are considered potential carcinogens, a Cancer Potency Factor (CPF) is presented. The CPF is expressed in units of inverse dosage, i.e., $(mg/kg/day)^{-1}$. Simply stated, it represents the increase in risk of cancer mortality per unit of exposure dosage. In most cases, CPFs are derived using data from animal experiments and by applying a low-dose extrapolation model that incorporates conservative assumptions concerning interspecies extrapolation.

For compounds not regarded as potential carcinogens, a Reference Dose (RfD), also called an Acceptable Intake for Chronic Exposure (AIC), is provided. This value represents the exposure dosage in mg/kg/day

which, if consumed daily throughout a person's lifetime, would not result in any adverse health effects. USEPA usually derives RfDs based on animal data which define a no-effect dosage or threshold for toxicity. This threshold value is divided by a conservative safety factor, typically 100 or 1,000, to derive a human RfD. These RfD values may then be used to determine a Hazard Index (HI) for given exposures. The HI is the ratio of the estimated exposure level to the RfD value. HI values greater than 1.0 may indicate a potential health risk.

As shown in Tables 9 and 10, not all of the compounds of interest have toxicity criteria available. As a result, they cannot be evaluated quantitatively and are not included in subsequent risk estimates. This should be considered as an area of uncertainty in the PHE.

The approach used to characterize risk in this section is analogous to the methods used in the original baseline RI risk assessment conducted by IT Corporation.

5.4   Risk Characterization

This section describes the potential risks associated with estimated exposure levels calculated as described previously.

For the adult worker exposure scenario, estimated incremental lifetime cancer risks and hazard indices are presented in Table 9. As shown in this table, the total estimated cancer risk associated with exposure

49   0255

to maximum concentrations of all of the chemicals of interest is 5.9 x 10^{-9} under the conditions of this scenario. The total HI for non-carcinogenic effects is 3.5 x 10^{-7}, which is far below the 1.0 value which indicates a potential hazard.

For the childhood/young adult exposure scenario, estimated incremental cancer risks and hazard indices are presented in Table 10. As shown in this table, the total estimated cancer risk associated with exposure to maximum concentrations of all contaminants of interest is 1.1 x 10^{-9}. The total HI for non-carcinogenic effects is 2.7 x 10^{-7}, which is far below the 1.0 HI which indicates a potential hazard.

6.   References

(1)   United States Environmental Protection Agency, <u>Screening Procedures For Estimating the Air Quality Impact of Stationary Sources (Draft)</u>, EPA-450/4-88-010, August 1988.

(2)   United States Environmental Protection Agency, <u>Guideline on Air Quality Models (Revised)</u>, EPA-450/2-78-027, July 1986.

(3)   Auer, A.H., <u>Correlation of Land and Cover With Meteorological Anomalies</u>, Journal of Applied Meteorology, 17, 1978, pp. 636-643.

(4)   40 CFR 51, Stack Height Regulations: Final Rule, 1985.

(5)   United States Environmental Protection Agency, Office of Solid Waste, <u>Guidance on Metals and Hydrogen Chloride Controls for Hazardous Waste Incinerator (Draft)</u>, March 1989.

(6)   American Conference of Governmental and Industrial Hygienists, <u>Threshold Limit Values and Biological Exposure Indices for 1989-1990</u>, 1989.

(7)   United States Environmental Protection Agency, <u>Superfund Exposure Assessment Manual, OSWER Directive 9285.5-1</u>, EPA 540/1-88/001, 1988.

(8)   United States Environmental Protection Agency, <u>Exposure Factors Handbook</u>, EPA/600/8-89/043, 1989.

49   0257

(9)   United States Environmental Protection Agency. <u>Health Effects Assessment</u>
      <u>Summary Tables</u>, OERR, 9200.6-303-(89-2), 1989.

FIGURE I

Zion Chapel No. 2
Cem
BM 140

x/33

/32

SITE

x/35

/40

SC

QUADRANGLE LOCATION

BM

//9

LEGEND

▲ PROPOSED LOCATION OF
AIR STRIPPER SYSTEM

I   5   0

K M.

SITE LOCATION MAP
SCRDI BLUFF ROAD SITE
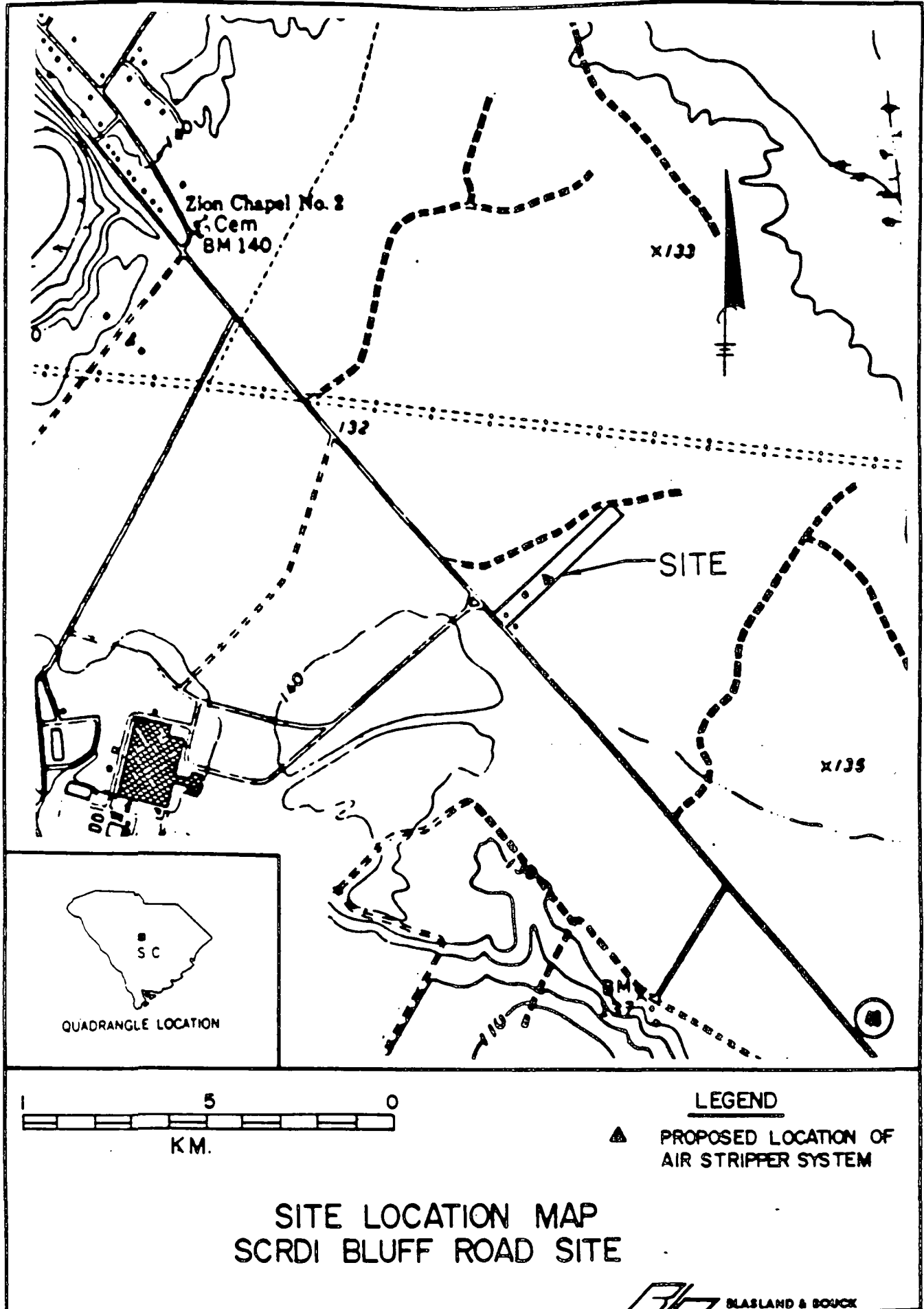
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ENGINEERS, P.C.

TABLE 1
SCRDI-BLUFF ROAD SITE
ESTIMATED AIR STRIPPER EMISSIONS

ANALYTE	STRIPPER INLET CONC MG/L	GROUND WATER FLOW RATE GPM	CONTAM. MASS LB/HR	g/SEC STRIPPER EMISSIONS 100%	g/sec EMISSIONS AFTER GAC CONTROL	AIR FLOW @100 A/H cu m/s	STACK DIAM. meters	STACK HEIGHT meters	EXIT VELOCITY M/SEC	TOTAL CONTROLLED EMISSIONS LBS/DAY
CARBON TETRACHLORIDE	0.08	100	0.004003	0.000504	5.05E-07	0.630833	0.61	9.144	2.158566	0.000096
ACETONE	4.428 *	100	0.221577	0.027943	2.79E-05					0.005317
CHLOROFORM	1.378	100	0.068955	0.008696	8.70E-06					0.001654
BENZENE	0.11	100	0.005504	0.000694	6.94E-07					0.000132
1,1,1-TRICHLOROETHANE	0.435	100	0.021767	0.002745	2.75E-06					0.000522
VINYL CHLORIDE	0.013	100	0.000650	0.000082	8.20E-08					0.000015
METHYLENE CHLORIDE	0.277 *	100	0.013861	0.001748	1.75E-06					0.000332
1,1-DICHLOROETHANE	2.551	100	0.127652	0.016098	1.61E-05					0.003063
1,1-DICHLOROETHENE	0.443	100	0.022167	0.002795	2.80E-06					0.000532
1,2-DICHLOROPROPANE	0.026	100	0.001301	0.000164	1.64E-07					0.000031
2-BUTANONE (MEK)	1.41	100	0.070556	0.008897	8.90E-06					0.001693
1,1,2-TRICHLOROETHANE	0.006	100	0.000300	0.000037	3.79E-08					0.000007
TRICHLOROETHENE	0.123	100	0.006154	0.000776	7.76E-07					0.000147
1,1,2,2-TETRACHLOROETHANE	0.122	100	0.006104	0.000769	7.70E-07					0.000146
ETHYL BENZENE	0.148	100	0.007405	0.000933	9.34E-07					0.000177
1,2-DICHLOROETHANE	0.19	100	0.009507	0.001199	1.20E-06					0.000228
4-METHYL-2-PENTANONE (MIBK)	0.184	100	0.009207	0.001161	1.16E-06					0.000220
TOLUENE	0.92 *	100	0.046036	0.005805	5.81E-06					0.001104
CHLOROBENZENE	0.02	100	0.001000	0.000126	1.26E-07					0.000024
TETRACHLOROETHENE	0.077	100	0.003853	0.000485	4.86E-07					0.000092
1,2-DICHLOROETHENE	2.222	100	0.111188	0.014022	1.40E-05					0.002668
XYLENES	0.25	100	0.01251	0.001577	1.58E-06					0.000300
1,2-DICHLOROBENZENE	0.25	100	0.01251	0.001577	1.58E-06					0.000300
1,4-DICHLOROBENZENE	0.01	100	0.000500	0.000063	6.31E-08					0.000012
2-CHLOROPHENOL	0.8	100	0.040032	0.005048	5.05E-06					0.000960
PHENOL	0.26	100	0.013010	0.001640	1.64E-06					0.000312
	16.733		0.837319	0.105595	1.06E-04					0.020096

*DOES NOT TAKE INTO ACCOUNT POTENTIAL BLANK CONTAMINATION. THIS
IS CONSIDERED WORST CASE FOR INFLUENT AND SUBSEQUENT EMISSIONS
ESTIMATES

TABLE 2

DESIGN STACK PARAMETERS FOR
TREATMENT OF GROUND WATER USING AN AIR STRIPPER

UTM Coordinates (km)		Stack Base Elevation (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Flow Rate (ACFM)	Exhaust Velocity (m/s)	Exhaust Gas Exit Temp. (°K)
Easting	Northing						
508.480	3749.380	41.76	9.14	0.61	1336	2.158566	293.15

TABLE 3

METEOROLOGICAL CONDITIONS USED FOR THE
PTPLU-2 SCREENING ANALYSIS

Stability Class	Wind Speed (m/s)
A	0.5, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0
B	0.5, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0
C	2.0, 2.5, 3.0, 4.0, 5.0, 7.0, 10.0, 12.0, 15.0
D	0.5, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.0, 10.0, 12.0, 15.0, 20.0
E	2.0, 2.5, 3.0, 4.0, 5.0
F	2.0, 2.5, 3.0, 4.0, 5.0

Note: The wind is assumed to be blowing directly from the source to the receptor.

TABLE 4

LOCATIONS OF DISCRETE FENCELINE MODELING RECEPTORS

UTM Coordinates (km)		Elevation	
Easting	Northing	Meters	Feet
508.340	3749.310	42.06	138
508.417	3749.374	42.06	138
508.494	3749.438	41.76	137
508.571	3749.502	41.76	137
508.648	3749.566	41.45	136
508.680	3749.593	41.45	136
508.703	3749.565	41.45	136
508.671	3749.538	41.45	136
508.594	3749.474	41.76	137
508.517	3749.410	41.76	137
508.440	3749.346	42.06	138
508.363	3749.282	42.06	138

TABLE 5

MAXIMUM PREDICTED
1-HOUR AND ANNUAL CONCENTRATIONS
FOR TREATMENT OF GROUND WATER USING AIR STRIPPING

Contaminant	Maximum Concentration (ug/m^3)	
Volatiles	1-Hour	Annual
Acetone	2.48×10^{-2}	5.07×10^{-4}
Chloroform	7.72×10^{-3}	1.58×10^{-4}
1,1,1-Trichloroethane	2.44×10^{-3}	5.00×10^{-5}
Methylene Chloride	1.55×10^{-3}	3.18×10^{-5}
1,1-Dichloroethane	1.43×10^{-2}	2.93×10^{-4}
2-Butanone	7.90×10^{-3}	1.62×10^{-4}
Trichloroethene	6.89×10^{-4}	1.41×10^{-5}
1,1,2,2-Tetrachloroethane	6.84×10^{-4}	1.40×10^{-5}
Ethylbenzene	8.29×10^{-4}	1.70×10^{-5}
Toluene	5.16×10^{-3}	1.06×10^{-4}
Chlorobenzene	1.12×10^{-4}	2.29×10^{-6}
Tetrachloroethene	4.31×10^{-4}	8.83×10^{-6}
1,2-Dichloroethene	1.24×10^{-2}	2.54×10^{-4}
Xylenes	1.40×10^{-3}	2.87×10^{-5}
Vinyl Chloride	7.28×10^{-5}	1.49×10^{-6}
1,1-Dichloroethene	2.48×10^{-3}	5.09×10^{-5}
Benzene	6.16×10^{-4}	1.26×10^{-5}
1,2-Dichloroethane	1.06×10^{-3}	2.18×10^{-5}
Carbon Tetrachloride	4.48×10^{-4}	9.18×10^{-6}
1,1,2-Trichloroethane	3.36×10^{-5}	6.89×10^{-7}
Methyl Isobutyl Ketone	1.03×10^{-3}	2.11×10^{-5}
1,2-Dichloropropane	1.45×10^{-4}	2.98×10^{-6}
Semivolatiles		
2-Chlorophenol	4.48×10^{-3}	9.18×10^{-5}
Phenol	1.46×10^{-3}	2.98×10^{-5}
1,2-Dichlorobenzene	1.40×10^{-3}	2.87×10^{-5}
1,4-Dichlorobenzene	5.60×10^{-5}	1.15×10^{-6}

TABLE 6

THRESHOLD LIMIT VALUES FOR AIR STRIPPER EMISSIONS

Contaminant	Maximum[1] 1-Hour Concentration (ug/m^3)	Threshold[2] Limit Values Time Weighted Averages (ug/m^3)
Volatiles		
Acetone	2.48×10^{-2}	1.78×10^{6}
Chloroform	7.72×10^{-3}	4.90×10^{4}
1,1,1-Trichloroethane	2.44×10^{-3}	1.91×10^{6}
Methylene Chloride	1.55×10^{-3}	1.74×10^{5}
1,1-Dichloroethane	1.43×10^{-2}	8.10×10^{5}
2-Butanone	7.90×10^{-3}	5.90×10^{5}
Trichloroethene	6.89×10^{-4}	2.69×10^{5}
1,1,2,2-Tetrachloroethane	6.84×10^{-4}	6.90×10^{3}
Ethylbenzene	8.29×10^{-4}	4.34×10^{5}
Toluene	5.16×10^{-3}	3.77×10^{5}
Chlorobenzene	1.12×10^{-4}	4.60×10^{4}
Tetrachloroethene	4.31×10^{-4}	3.39×10^{5}
1,2-Dichloroethene	1.24×10^{-2}	3.47×10^{5}
Xylenes	1.40×10^{-3}	4.34×10^{5}
Vinyl Chloride	7.28×10^{-5}	1.30×10^{4}
1,1-Dichloroethene	2.48×10^{-3}	2.00×10^{4}
Benzene	6.16×10^{-4}	3.20×10^{4}
1,2-Dichloroethane	1.06×10^{-3}	4.00×10^{4}
Carbon Tetrachloride	4.48×10^{-4}	3.10×10^{4}
1,1,2-Trichloroethane	3.36×10^{-5}	5.50×10^{4}
Methyl Isobutyl Ketone	1.03×10^{-3}	2.05×10^{5}
1,2-Dichloropropane	1.45×10^{-4}	3.50×10^{5}
Semivolatiles		
2-Chlorophenol	4.48×10^{-3}	
Phenol	1.46×10^{-3}	1.90×10^{4}
1,2-Dichlorobenzene	1.40×10^{-3}	3.00×10^{5}
1,4-Dichlorobenzene	5.60×10^{-5}	4.50×10^{5}

TABLE 7

EXPOSURE SCENARIO FOR WORKER
INHALATION OF AIRBORNE CONTAMINANTS FROM
GROUND WATER AIR STRIPPING EMISSIONS

Receptors:	On-site workers
Adult or Child:	Adult
Male/Female:	Male
Activity Level:	Moderate
Frequency of Event:	5840 days (16 years)
Duration of Event:	8 hours/day
Inhalation Rate:	2.8 m^3/hour [7]
Weight:	70 kg [8]

Potential Exposure Pathways Considered Significant:

Inhalation of Ambient Air

Compounds:	All site-specific chemicals.
Data Sets:	Maximum annual concentrations predicted from modeling ground water air stripping emissions.

TABLE   8

EXPOSURE SCENARIO FOR CHILD AT OFF-SITE AREA
INHALATION OF AIRBORNE CONTAMINANTS FROM
GROUND WATER AIR STRIPPING EMISSIONS

Receptors:	Child (age 6 through 21 years)
Adult or Child:	Child
Male/Female:	Male
Activity Level:	Moderate activity
Frequency of Event:	5840 days (16 years)
Duration of Event:	4 hours/day
Inhalation Rate:	2.7 m^3/hour [7]
Weight:	50 kg [8]

Potential Exposure Pathways Considered Significant:

Inhalation of Ambient Air

Compounds:	All site-specific chemicals.
Data Sets:	Maximum annual concentrations predicted from modeling ground water air stripping emissions.

TABLE 9

RISK CALCULATIONS FOR WORKERS
INHALATION OF AIRBORNE CONTAMINANTS
FROM GROUND WATER AIR STRIPPING EMISSIONS

Contaminant	Maximum Annual Air Concent. (ug/m^3)	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF (mg/kg/day)$^{-1}$	Inhalation AIC/RfD (mg/kg/day)	Risk	Hazard Index
Volatiles						
Acetone	5.07×10^{-4}	3.7×10^{-8}				
Chloroform	1.58×10^{-4}	1.2×10^{-8}	8.1×10^{-2}		9.3×10^{-10}	
1,1,1-Trichloroethane	5.00×10^{-5}	3.7×10^{-9}		3.0×10^{-1}		1.2×10^{-8}
Methylene Chloride	3.18×10^{-5}	2.3×10^{-9}	1.4×10^{-2}		3.3×10^{-11}	
1,1-Dichloroethane	2.93×10^{-4}	2.1×10^{-8}		1.0×10^{-1}		2.1×10^{-7}
2-Butanone	1.62×10^{-4}	1.2×10^{-8}				
Trichloroethene	1.41×10^{-5}	1.0×10^{-9}	1.3×10^{-2}		1.3×10^{-11}	
1,1,2,2-Tetrachloroethane	1.40×10^{-5}	1.0×10^{-9}	2.0×10^{-1}		2.0×10^{-10}	
Ethylbenzene	1.70×10^{-5}	1.2×10^{-9}				
Toluene	1.06×10^{-4}	7.7×10^{-9}		1.0		7.7×10^{-9}
Chlorobenzene	2.29×10^{-6}	1.7×10^{-10}		5.0×10^{-3}		3.3×10^{-8}
Tetrachloroethene	8.83×10^{-6}	6.4×10^{-10}	3.3×10^{-3}		2.1×10^{-12}	
1,2-Dichloroethene	2.54×10^{-4}	1.9×10^{-8}				
Xylenes	2.87×10^{-5}	2.1×10^{-9}		4.0×10^{-1}		5.2×10^{-9}
Vinyl Chloride	1.49×10^{-6}	1.1×10^{-10}	2.9×10^{-1}		3.2×10^{-11}	
1,1-Dichloroethene	5.09×10^{-5}	3.7×10^{-9}	1.2		4.5×10^{-9}	
Benzene	1.26×10^{-5}	9.2×10^{-10}	2.9×10^{-2}		2.7×10^{-11}	
1,2-Dichloroethane	2.18×10^{-5}	1.6×10^{-9}	9.1×10^{-2}		1.4×10^{-10}	
Carbon Tetrachloride	9.18×10^{-6}	6.7×10^{-10}	1.3×10^{-1}		8.7×10^{-11}	
1,1,2-Trichloroethane	6.89×10^{-7}	5.0×10^{-11}	5.7×10^{-2}		2.9×10^{-12}	
Methyl Isobutyl Ketone	2.11×10^{-5}	1.5×10^{-9}		2.0×10^{-2}		7.7×10^{-8}
1,2-Dichloropropane	2.98×10^{-6}	2.2×10^{-10}				

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TABLE 9 (Cont'd.)

RISK CALCULATIONS FOR WORKERS
INHALATION OF AIRBORNE CONTAMINANTS
FROM GROUND WATER AIR STRIPPING EMISSIONS

Contaminant	Maximum Annual Air Concent. (ug/m^3)	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RfD (mg/kg/day)	Risk	Hazard Index
Semivolatiles						
2-Chlorophenol	9.18×10^{-5}	6.2×10^{-10}				
Phenol	2.98×10^{-5}	2.0×10^{-10}				
1,2-Dichlorobenzene	2.87×10^{-5}	1.9×10^{-10}		4.0×10^{-2}		4.8×10^{-9}
1,4-Dichlorobenzene	1.15×10^{-6}	7.8×10^{-12}				
				TOTAL:	5.9×10^{-9}	3.5×10^{-7}

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TABLE 10

RISK CALCULATIONS FOR CHILD (AGE 6 THROUGH 21 YEARS)
INHALATION OF AIRBORNE CONTAMINANTS
FROM GROUND WATER AIR STRIPPING EMISSIONS

Contaminant	Maximum Annual Air Concent. (ug/m^3)	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RfD (mg/kg/day)	Risk	Hazard Index
Volatiles						
Acetone	5.07×10^{-4}	2.5×10^{-8}				
Chloroform	1.58×10^{-4}	7.8×10^{-9}	8.1×10^{-2}		6.3×10^{-10}	
1,1,1-Trichloroethane	5.00×10^{-5}	2.5×10^{-9}		3.0×10^{-1}		8.2×10^{-9}
Methylene Chloride	3.18×10^{-5}	1.6×10^{-9}	1.4×10^{-2}		2.2×10^{-11}	
1,1-Dichloroethane	2.93×10^{-4}	1.4×10^{-8}		1.0×10^{-1}		1.4×10^{-7}
2-Butanone	1.62×10^{-4}	8.0×10^{-9}				
Trichloroethene	1.41×10^{-5}	6.9×10^{-10}	1.3×10^{-2}		9.0×10^{-12}	
1,1,2,2-Tetrachloroethane	1.40×10^{-5}	6.9×10^{-10}	2.0×10^{-1}		1.4×10^{-10}	
Ethylbenzene	1.70×10^{-5}	8.4×10^{-10}				
Toluene	1.06×10^{-4}	5.2×10^{-9}		1.0		5.2×10^{-9}
Chlorobenzene	2.29×10^{-6}	1.1×10^{-10}		5.0×10^{-3}		2.3×10^{-8}
Tetrachloroethene	8.83×10^{-6}	4.4×10^{-10}	3.3×10^{-3}		1.4×10^{-12}	
1,2-Dichloroethene	2.54×10^{-4}	1.3×10^{-8}				
Xylenes	2.87×10^{-5}	1.4×10^{-9}		4.0×10^{-1}		3.5×10^{-9}
Vinyl Chloride	1.49×10^{-6}	7.3×10^{-11}	2.9×10^{-1}		2.1×10^{-11}	
1,1-Dichloroethene	5.09×10^{-5}	2.5×10^{-9}	1.2		8.8×10^{-11}	
Benzene	1.26×10^{-5}	6.2×10^{-10}	2.9×10^{-2}		7.3×10^{-11}	
1,2-Dichloroethane	2.18×10^{-5}	1.1×10^{-9}	9.1×10^{-2}		5.6×10^{-11}	
Carbon Tetrachloride	9.18×10^{-6}	4.5×10^{-10}	1.3×10^{-1}		5.9×10^{-11}	
1,1,2-Trichloroethane	6.89×10^{-7}	3.4×10^{-11}	5.7×10^{-2}		1.9×10^{-12}	
Methyl Isobutyl Ketone	2.11×10^{-5}	1.0×10^{-9}		2.0×10^{-2}		5.2×10^{-8}
1,2-Dichloropropane	2.98×10^{-6}	1.5×10^{-10}				

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TABLE 10 (Cont'd.)

RISK CALCULATIONS FOR CHILD (AGE 6 THROUGH 21 YEARS)
INHALATION OF AIRBORNE CONTAMINANTS
FROM GROUND WATER AIR STRIPPING EMISSIONS

Contaminant	Maximum Annual Air Concent. $(\mu g/m^3)$	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RfD (mg/kg/day)	Risk	Hazard Index
Semivolatiles						
2-Chlorophenol	9.18×10^{-5}	4.5×10^{-9}				
Phenol	2.98×10^{-5}	1.5×10^{-9}				
Dichlorobenzene	2.87×10^{-5}	1.4×10^{-9}		4.0×10^{-2}		3.5×10^{-8}
1,4-Dichlorobenzene	1.15×10^{-6}	5.7×10^{-11}				
				TOTAL:	1.1×10^{-9}	2.7×10^{-7}

APPENDIX D

WETLANDS IMPACT SUMMARY

APPENDIX D

The top 5 to 15 feet of soil over most of the wetland area portion of the site as defined in the attached letter from the Corps of Engineers dated January 23, 1990 consists of a low permeability layer of varying amounts of clay, silt and sand. Laboratory permeability test performed on this material provided hydraulic conductivity values of 2.6×10^{-5} cm/sec to 1.6×10^{-8} cm/sec (medium of 2×10^{-6} cm/sec), values typical of a clayey silt material. Underlying the low permeability layer is a layer of sand extending to a depth of 45 to 50 feet. The hydraulic conductivity of the sand averages 4×10^{-2} cm/sec based on a pumping test conducted by Golder Associates. According to water level measurements collected by Golder Associates in 1985 and by IT Corporation in 1989, the water table is 5 to 10 feet below ground surface and typically within the low permeability layer. Due to the fine grained nature of the low permeability layer, the capillary fringe would be expected to rise 3 to 6 feet above the water table (Todd, 1980). The capillary fringe in the underlying sand would be expected to be less than one foot.

Portions of the wetland area that are underlain by the low permeability layer tend to be perennially wet. This condition is likely the combined result of the high water table and the ability of the clayey silt material to retain infiltrating precipitation.

The presence of a near-surface capillary fringe may play an important role in providing a readily available and ample source of water to shallow-rooted plants in the wetland during periods without significant precipitation.

If ground water pumping is implemented, localized areas of the

water table could be lowered to below the bottom of the low permeability layer, locally and into the underlying sand (a distance of 8 feet to less than 1 foot below the water table). The actual drop in the saturated zone (top of the capillary fringe with respect to a source of water from plants), is the combined drop of the water table and the difference between pre-and post-pumping capillary fringes. An example pointing out the importance of considering the capillary fringe would involve an area in which the low permeability layer was predominantly clay, the prepumping water table was within the bottom few inches of the clay and the capillary fringe (and constant source of water for plant roots) extended 6 feet above the water table. If pumping resulted in lowering the water table approximately one foot and the resulting capillary fringe no longer extended into the clay, the net effect to the plants would be that their source of water (that portion previously derived from the ground water) would be lowered by over 6 feet.

The actual effect upon plant life due to lowering of the water table will depend on several factors including the placement of the extraction wells, pumping rates, position of the static water table within the geologic strata, and the species of plants within the areas affected by the pumping.

Once the extraction well network is defined, the potential impact on the Wetland area will require evaluation, possibly during a pump test.

DEPARTMENT OF THE ARMY
CHARLESTON DISTRICT CORPS OF ENGINEERS
P O. BOX 919
CHARLESTON. S C 29402-0919

REPLY TO
ATTENTION OF

January 23, 1990

Regulatory Branch

Mr. Richard Haynes
S.C. Department of Health and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Dear Mr. Haynes:

This is in response to your request for a Department of the Army wetland determination on a tract of approximately 7 acres known as the Bluff Road Solid Waste Site in Richland County, South Carolina. You also asked if the site was located in a flood plain.

Based on a review of aerial photographs and further investigation into this matter, I have determined that the referenced property contains jurisdictional wetlands, and as such, a Department of the Army permit will be required for the placement of dredged or fill material in such areas. However, since the site of the proposed work is located above the head water of this waterbody, headwater being defined as the point at which the mean annual average flow is less than five cubic feet per second, filling up to one acre may be authorized by a nationwide permit provided the criteria highlighted in the enclosed extract (33 CFR 330.5[a][26]) can be met. In addition, please be advised that this authorization is only valid for a period of two years from the date of this letter. Should the work not be completed within this time frame or should the nationwide permit be modified, be revoked or expire prior to completion of the work authorized, such work may not be conducted without additional Corps of Engineers' authorization. However, if the work authorized by this letter has commenced in accordance with the requisite terms and conditions or you, acting in reliance on this nationwide permit, have entered into a contract to have this work performed prior to such date, this authorization will remain in effect for an additional twelve months. Should you find that the work you propose cannot meet these provisions, you must submit an application for an "individual" Department of the Army permit for this activity.

The wetland areas have been approximated on the enclosed sketch dated January 22, 1990. The approximate wetland lines are for preliminary planning purposes only and will have to be confirmed by this office before any construction commences. Please find enclosed a list of wetland delineation consultants to assist you in determining the exact onsite limits of Department of the Army jurisdiction. According to our Hydraulics, Coastal, and Flood Plain Management Section, the referenced property is not located within a special flood hazard area. A copy of this letter is being forwarded to the addressees listed on the attachment for their information.

-2-

In addition, please be advised that this jurisdictional determination is only valid for a period of two years from the date of this letter. All actions concerning this determination must be completed within this time frame or an additional Corps of Engineers' delineation may be required.

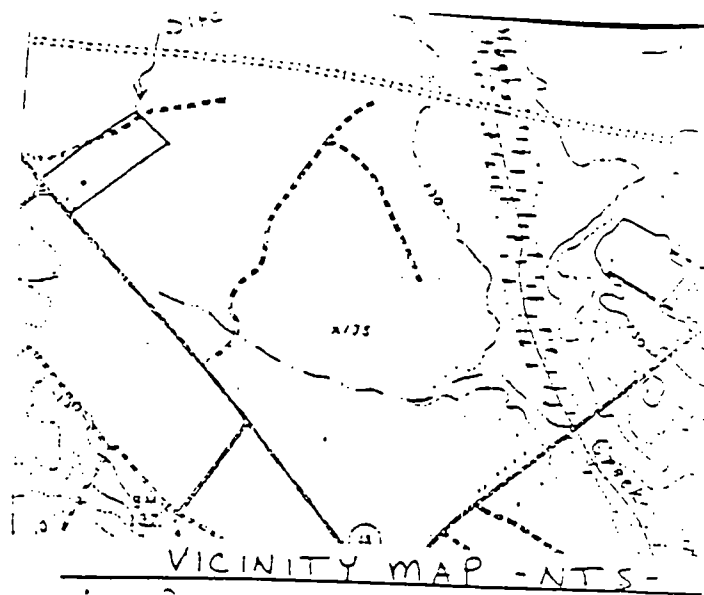If you have any questions concerning this matter, please contact me at A/C 803-724-4330.

Sincerely,

S. A. Danker
Regulatory Branch

enclosure
consultant list
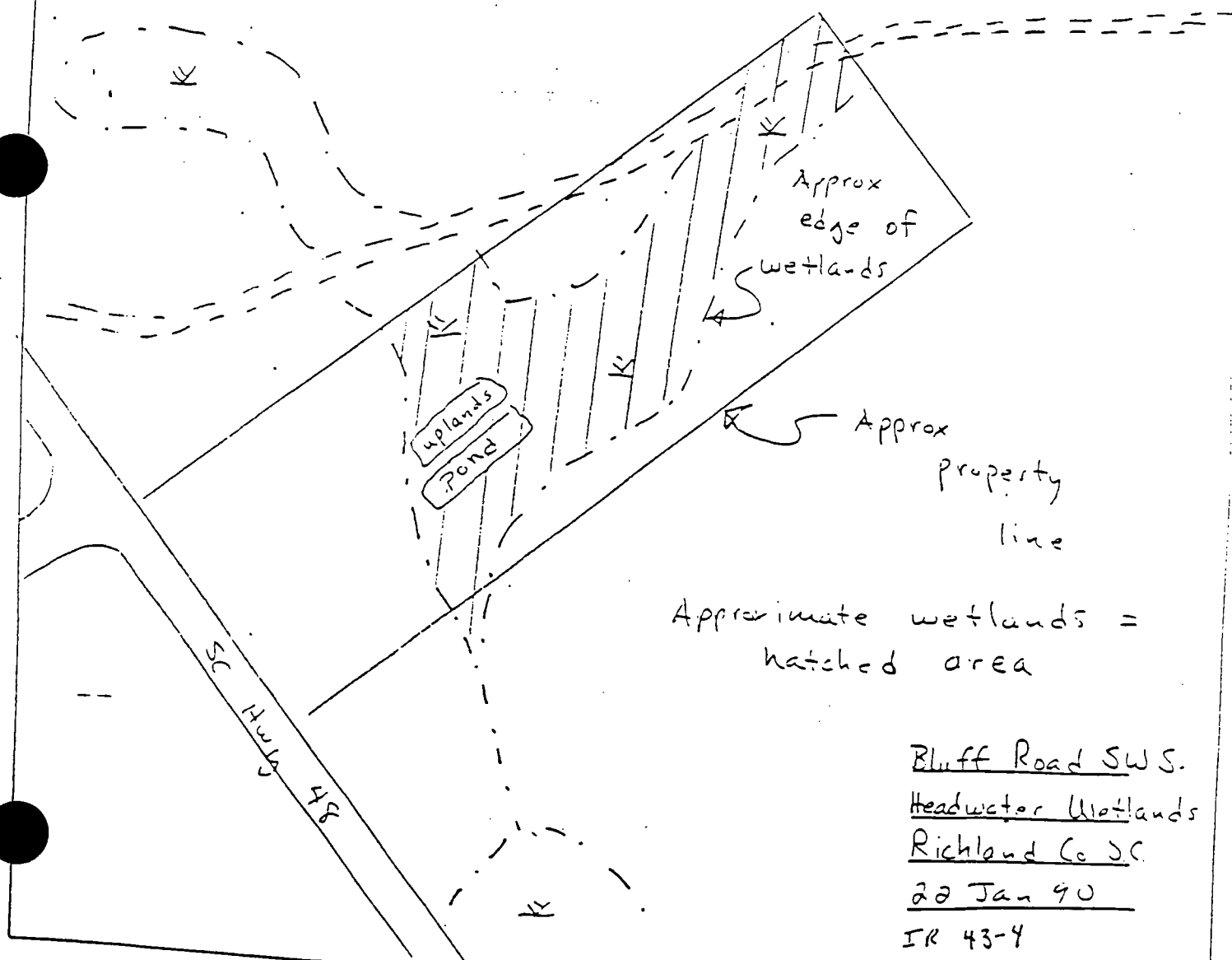26 extract
sketch

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VICINITY MAP -NTS-
Richland Co SC

Approx
edge of
wetlands

Approx
property
line

uplands
Pond

Approximate wetlands =
hatched area

SC Hwy 48

Bluff Road SWS.
Headwater Wetlands
Richland Co SC
22 Jan 90
IR 43-4

NATIONWIDE PERMITS

Effective January 12, 1987

The following listed activities, given in 33 CFR Part 330, are permitted provided they meet the conditions listed in 33 CFR Part 330.5(b) and, where required, comply with the notification procedures of 33 CFR Part 330.7.

1. The placement of aids to navigation and regulatory markers which are approved by and installed in accordance with the requirements of the U.S. Coast Guard (see 33 CFR Part 66, Subchapter C). (Section 10)

2. Structures constructed in artificial canals within principally residential developments where the connection of the canal to a navigable water of the United States has been previously authorized (see 33 CFR Part 322.5(g)). (Section 10)

3. The repair, rehabilitation, or replacement of any previously authorized, currently serviceable, structure or fill, or of any currently serviceable structure or fill constructed prior to the requirement for authorization, provided such repair, rehabilitation, or replacement does not result in a deviation from the plans of the original structure or fill, and further provided that the structure or fill has not been put to uses differing from uses specified for it in any permit authorizing its original construction. Minor deviations due to changes in materials or construction techniques and which are necessary to make repair, rehabilitation, or replacement are permitted. Maintenance dredging and beach restoration are not authorized by this nationwide permit. (Section 10 and 404)

4. Fish and wildlife harvesting devices and activities such as pound nets, crab traps, eel pots, lobster traps, duck blinds, and clam and oyster digging. (Section 10)

5. Staff gages, tide gages, water recording devices, water quality testing and improvement devices, and similar scientific structures. (Section 10)

6. Survey activities including core sampling, seismic exploratory operations, and plugging of seismic shot holes and other exploratory-type bore holes. Drilling of exploration-type bore holes for oil and gas exploration is not authorized by this nationwide permit; the plugging of such holes is authorized. (Sections 10 and 404).

7. Outfall structures and associated intake structures where the effluent from that outfall has been permitted under the National Pollutant Discharge Elimination System program (Section 402 of the Clean Water Act) (see 40 CFR Part 122) provided that the district or division engineer makes a determination that the individual and cumulative adverse environmental effects of the structure itself are minimal in accordance with 33 CFR Parts 330.7 (c)(2) and 330.7 (d). Intake structures per se are not included, only those directly associated with an outfall structure are covered by this nationwide permit. This permit includes minor excavation, filling and other work associated with installation of the intake and outfall structures. (Sections 10 and 404)

8. Structures for the exploration, production, and transportation of oil, gas, and minerals on the outer continental shelf within areas leased for such purposes by the Department of Interior, Mineral Management Service, provided those structures are not placed within the limits of any designated shipping safety fairway or traffic separation scheme (where such limits have not been designated or where changes are anticipated, District Engineers will consider recommending the discretionary authority provided by 33 CFR Part 330.8, and further subject to the provisions of the fairway regulations in 33 CFR 322.5(1). (Section 10)

9. Structures placed within anchorage or fleeting areas to facilitate moorage of vessels where such areas have been established for that purpose by the U.S. Coast Guard. (Section 10)

10. Non-commercial, single-boat, mooring buoys. (Section 10)

11. Temporary buoys and markers placed for recreational use such as water skiing and boat racing provided that the buoy or marker is removed within 30 days after its use has been discontinued. At Corps of Engineers reservoirs, the reservoir manager must approve each buoy or marker individually. (Section 10)

12. Discharge of material for backfill or bedding for utility lines, including outfall and intake structures, provided there is no change in preconstruction bottom contours (excess material must be removed to an upland disposal area). A "utility line" is defined as any pipe or pipeline for the transportation of any gaseous, liquid, liquefiable, or slurry substance, for any purpose, and any cable, line, or wire for the transmission for any purpose of electrical energy, telephone and telegraph messages, and radio and television communication. (The utility line and outfall and intake structures will require a Section 10 permit if in navigable waters of the United States. See 33 CFR Part 322. See also nationwide permit #7 given above). (Section 404)

13. Bank stabilization activities provided:

   a. the bank stabilization activity is less than 500 feet in length;

   b. the activity is necessary for erosion prevention;

   c. the activity is limited to less than an average of one cubic yard per running foot placed along the bank within waters of the United States;

   d. no material is placed in excess of the minimum needed for erosion protection;

   e. no material is placed in any wetland area;

   f. no material is placed in any location or in any manner so as to impair surface water flow into or out of any wetland area;

   g. only clean material free of waste metal products, organic materials, unsightly debris, etc., is used; and

   h. the activity is a single and complete project. (Sections 10 and 404)

14. Minor road crossing fills including all attendant features, both temporary and permanent, that are part of a single and complete project for crossing of a non-tidal waterbody, provided that the crossing is culverted, bridged or otherwise designed to prevent the restriction of, and to withstand, expected high flows and provided further that discharges into any wetlands adjacent to the waterbody do not extend beyond 100 feet on either side of the ordinary high water mark of that waterbody. A "minor road crossing fill" is defined as a crossing that involves the discharge of less than 200 cubic yards of fill material below the plane of ordinary high water. The crossing may require a permit from the US Coast Guard if located in navigable waters of the United States. Some road fills may be eligible for an exemption from the need for a Section 404 permit altogether (see 33 CFR 323.4). District Engineers are authorized, where local circumstances indicate the need, to define the term "expected high flows" for the purpose of establishing applicability of this nationwide permit. (Sections 10 and 404)

15. Discharges of dredged or fill material incidental to the construction of bridges across navigable waters of the United States, including cofferdams, abutments, foundation seals, piers, and temporary construction and access fills provided such discharge has been authorized by the US Coast Guard as part of the bridge permit. Causeways and approach fills are not included in this nationwide permit and will require an individual or regional Section 404 permit. (Section 404)

16. Return water from an upland, contained dredged material disposal area (see 33 CFR 323.2(d)) provided the state has issued a site specific or generic certification under section 401 of the Clean Water Act (see also 33 CFR 325.2(b)(1)). The dredging itself requires a Section 10 permit if located in navigable waters of the United States. The return water or runoff from a contained disposal area is administratively defined as a discharge of dredged material by 33 CFR 323.2(d) even though the disposal itself occurs on the upland and thus does not require a section 404 permit. This nationwide permit satisfies the technical requirement for a section 404 permit for the return water where the quality of the return water is controlled by the state through the section 401 certification procedures. (Section 404)

17. Fills associated with small hydropower projects at existing reservoirs where the project which includes the fill is licensed by the Federal Energy Regulatory Commission (FERC) under the Federal Power Act of 1920, as amended; has a total generating capacity of not more than 1500 kw (2,000 horsepower); qualifies for the short-form licensing procedures of the FERC (see 18 CFR 4.61); and the district or division engineer makes a

determination that the individual and cumulative adverse effects on the environment are minimal in accordance with 33 CFR Parts 330.7 (c)(2) and 330.7 (d). (Section 404)

18. Discharges of dredged or fill material into all waters of the United States other than wetlands that do not exceed ten cubic yards as part of a single and complete project provided the material is not placed for the purpose of stream diversion. (Sections 10 & 404)

19. Dredging of no more than ten cubic yards from navigable waters of the United States as part of a single and complete project. This permit does not authorize the connection of canals or other artificial waterways to navigable waters of the United States (see Section 33 CFR 322.5(g)). (Section 10)

20. Structures, work, and discharges for the containment and cleanup of oil and hazardous substances which are subject to the National Oil and Hazardous Substances Pollution Contingency Plan, (40 CFR Part 300), provided the Regional Response Team which is activated under the Plan concurs with the proposed containment and cleanup action. (Sections 10 & 404)

21. Structures, work, discharges associated with surface coal mining activities provided they were authorized by the Department of the Interior, Office of Surface Mining, or by states with approved programs under Title V of the Surface Mining Control and Reclamation Act of 1977; the appropriate District Engineer is given the opportunity to review the Title V permit application and all relevant Office of Surface Mining or state (as the case may be) documentation prior to any decision on that application; and the district or division engineer makes a determination that the individual and cumulative adverse effects on the environment from such structures, work, or discharges are minimal in accordance with 33 CFR Parts 330.7(c)(2) and 330.7(c)(3) and 330.7(d). (Sections 10 and 404)

22. Minor work, fills, or temporary structures required for the removal of wrecked, abandoned, or disabled vessels, or the removal of man-made obstructions to navigation. This permit does not authorize maintenance dredging, shoal removal, or river bank snagging. (Sections 10 & 404)

23. Activities, work, and discharges undertaken, assisted, authorized, regulated, funded, or financed, in whole or in part, by another federal agency or department where that agency or department has determined, pursuant to the CEQ Regulation for Implementing the Procedural Provisions of the National Environmental Policy Act (40 CFR Part 1500 et seq.), that the activity, work, or discharge is categorically excluded from environmental documentation because it is included within a category of actions which neither individually nor cumulatively have a significant effect on the human environment, and the Office of the Chief of Engineers (ATTN: DAEN-CWO-N) has been furnished notice of the agency's or department's application for the categorical exclusion and concurs with that determination. Prior to approval for purposes of this nationwide permit of any agency's categorical exclusions, the Chief of Engineers will solicit comments through publication in the Federal Register. (Sections 10 & 404)

24. Any activity permitted by a state administering its own Section 404 permit program for the discharge of dredged or fill material authorized at 33 U.S.C. 1344(g)-(l) is permitted pursuant to section 10 of the Rivers and Harbors Act of 1899. Those activities which do not involve a section 404 state permit are not included in this nationwide permit but many will be exempted by Sec. 154 of PL 94-587. (See 33 CFR 322.3(a)(2)) (Section 10)

25. Discharge of concrete into tightly sealed forms or cells where the concrete is used as a structural member which would not otherwise be subject to Clean Water Act jurisdiction. (Section 404)

26. Discharges of dredged or fill material into the waters listed below, except those which cause the loss or substantial adverse modification of 10 acres or more of such waters of the United States, including wetlands. For discharges which cause the loss or substantial adverse modification of 1 to 10 acres of such waters, including wetlands, notification to the District Engineer is required in accordance with 33 CFR Part 330.7. (Section 404)

   a. Non-tidal rivers, streams, and their lakes and impoundments, including adjacent wetlands, that are located above the headwaters.

   b. Other non-tidal waters of the United States, including adjacent wetlands, that are not part of a surface tributary system to interstate waters or navigable waters of the United States (i.e. isolated waters).

The following activities were permitted by nationwide permits issued on July 19, 1977, and unless modified do not require further permitting:

1. Discharges of dredged or fill material into waters of the United States outside the limits of navigable waters of the United States that occurred before the phase-in dates which began July 25, 1975, and extended section 404 jurisdiction to all waters of the United States. (These phase-in dates are: After July 25, 1975, discharges into navigable waters of the United States and adjacent wetlands; after September 1, 1976, discharges into navigable waters of the United States and their primary tributaries, including adjacent wetlands, and into natural lakes, greater than 5 acres in surface area; and after July 1, 1977, discharges into all waters of the United States). (Section 404)

2. Structures or work completed before December 18, 1968, or in waterbodies over which the District Engineer had not asserted jurisdiction at the time the activity occurred provided, in both instances, there is no interference with navigation. (Section 10)

Other Information

District Engineers are authorized to determine if an activity complies with the terms and conditions of a nationwide permit unless that decision must be made by the Division Engineer in accordance with 33 CFR Part 330.7.

General permittees may, and in some cases must, request from a District Engineer confirmation that an activity complies with the terms and conditions of a nationwide permit. District Engineers will respond promptly to such requests. The response will state that the verification is valid for a period of no more than two years or a lesser period of time if deemed appropriate. If the District Engineer decides that an activity does not comply with the terms or conditions of a general permit, he will so notify the person desiring to do the work and indicate that an individual permit is required.

Nationwide permits do not obviate the need to obtain other Federal, state or local authorizations required by law.

Nationwide permits do not authorize interference with any existing or proposed Federal project.

Nationwide permits do not authorize any injury to the property or rights of others.

Nationwide permits do not grant any property rights or exclusive privileges.

It is incumbent upon the permittee to remain informed of changes to nationwide permits.

Expiration of Nationwide Permits

The Chief of Engineers will review nationwide permits on a continual basis, and will decide to either modify, reissue (extend) or revoke the permits at least every five years. If a nationwide permit is not modified or reissued within five years of publication in the Federal Register, it automatically expires and becomes null and void. Authorization of activities which have commenced or are under contract to commence in reliance upon a nationwide permit will remain in effect provided the activity is completed within twelve months of the date a nationwide permit has expired or was revoked unless discretionary permit authority has been exercised in accordance with 33 CFR Part 330.8 or modification, suspension, or revocation procedures are initiated in accordance with the relevant provisions of 33 CFR Part 325.7. Activities completed under the authorization of a nationwide permit which was in effect at the time the activity was completed continue to be authorized by that nationwide permit.

APPENDIX E

AIR QUALITY IMPACT ANALYSIS AND PUBLIC HEALTH EVALUATION FOR TREATMENT OF SOIL USING SOIL VENTING

AIR QUALITY IMPACT ANALYSIS AND PUBLIC HEALTH EVALUATION FOR TREATMENT OF SOIL USING SOIL VENTING AT THE SCRDI BLUFF ROAD SITE

An evaluation to assess the health effects associated with air emissions from the on-site treatment of soil using soil venting at the SCRDI Bluff Road site is presented in this document. Air quality dispersion modeling was performed to predict maximum ambient air impacts to support this evaluation. Long-term modeling was conducted to determine maximum annual impacts using 5 years of regional National Weather Service (NWS) meteorological data. Short-term impacts were evaluated using a screening model to estimate the maximum 1-hour concentrations based on a worst-case combination of atmospheric stability and wind speed.

Section 1 discusses the dispersion modeling techniques employed. Section 2 presents the input data used. Section 3 describes the procedure for modeling receptor selection. Section 4 presents the dispersion modeling results. Section 5 presents the public health evaluation.

1.   Dispersion Modeling Techniques

Both screening and refined modeling were conducted as part of the air quality dispersion analysis. For short-term impacts (24 hours or less), the United States Environmental Protection Agency (USEPA) recommends use of a screening model to estimate conservative short-term impacts for pollutants released from a stationary source.[1] If, based on appropriate screening techniques, the concentration of a pollutant is predicted below an acceptable

health-based level, no further modeling of the pollutant is required due to the conservative nature of the prediction. If, on the other hand, the predicted concentration is above this acceptable health-based level, a refined modeling analysis is necessary to predict the short-term maximum concentration.

USEPA recommendations contained in Guideline on Air Quality Models (Revised)[2] were used to select the appropriate dispersion models. Three factors were considered:

a.   Whether the area is classified as urban or non-urban according to USEPA modeling protocols;

b.   Whether it is necessary to consider plume impact upon complex terrain; and

c.   Whether it is necessary to consider building-induced aerodynamic downwash effects.

Figure 1 presents a site location map depicting the site boundary and surrounding area. The area surrounding the site is non-urban based on recommended USEPA classification procedures. The recommended method is to apply the Auer Classification Scheme[3] to classify land use patterns within 3 km of a site. United States Geological Survey (USGS) topographic maps for the site and vicinity clearly indicate that the area is non-urban; therefore modeling was conducted in the non-urban or rural mode.

The proposed stack height and results of the screening modeling are used to determine whether plume impact upon complex terrain need be considered. Preliminary screening modeling results based on a proposed stack height of 30 feet indicated that maximum impacts (discussed further in Section 4) would occur well within 2.0 kilometers of the source. The area surrounding the site (within 2.0 km) has terrain elevations ranging from 25 feet above to 22 feet below stack base elevation. In accordance with USEPA guidance,[2] it is not necessary to consider plume impact upon terrain; therefore, a simple terrain model was used.

Finally, as designed, the soil venting system will achieve a Good Engineering Practice (GEP) stack height based on nearby and/or adjacent building geometry.[4] As such, it was not necessary to model aerodynamic building-induced downwash effects.

Based on the above considerations, the Industrial Source Complex Long-Term (ISCLT) model was used to predict annual concentrations, and the Point-Plume-2 (PTPLU-2) model was used to predict maximum 1-hour concentrations. Results using the PTPLU-2 model were also employed to select receptors for use in modeling with ISCLT model. Options used in ISCLT and PTPLU-2 are consistent with USEPA guidance.[2] For both models, the options selected included the adjustment of the stack height for stack tip downwash, determination of final plume rise for all downwind receptor locations, and use of rural-mode wind profile coefficients. Because the soil venting system exhaust gas will be emitted at ambient temperature, plume enhancement due to buoyancy effects was not considered.

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2.   Input Data Used

The dispersion modeling analysis to evaluate air quality impacts from on-site soil venting required development and input of a detailed emissions inventory, and assembly and input of representative meteorological data. Each of these two areas is discussed below.

2.1 Emissions Inventory

Table 1 presents stack emission rates and associated input data. Table 2 presents design stack parameters. Based on vendor input, the rate of removal of organic compounds from soil and the resultant soil venting stack emission rates were determined.   Input by the vendor and subsequent engineering judgement were used to estimate the mass of organic contaminants present at the site. Based on existing soil data, it was estimated that 2,000 pounds of organic contaminants are present in 16,000 cubic yards of soil. However, because of potential gaps in the existing soil data, a worst-case scenario was used in which the total volume of contaminated soil at the site was assumed to be 45,000 cubic yards. This volume translates into a conservative total of 5,625 pounds of organic contaminants. Based on an extraction flow rate of 750 cubic feet per minute, the vendor-estimated time required to complete remediation of soils to established clean-up levels would be 18 months.

Based on the above assumptions, estimated emission rates with and without controls are presented in Table 1 for each contaminant of concern. The proposed air pollution control (APC) system consists of a vapor-phase activated carbon system with a removal efficiency of greater than 99.9 percent. Contaminant impacts upon ambient air quality were predicted based on emission rates for this APC system.

2.2 Meteorological Data

Representative meteorology was used in the screening modeling using PTPLU-2 and refined modeling using ISCLT.

Table 3 presents the meteorological conditions used for the PTPLU-2 screening analysis. PTPLU-2 predicts the maximum downwind concentrations based on discrete combinations of stability class and wind speed, and does not require actual meteorology representative of the source location.

The ISCLT model employed 5 years of annual stability array (STAR) data based on hourly observations from the NWS station in Columbia, South Carolina. The data provides annual joint frequencies of stability versus wind speed and wind direction. The period of record employed was the years 1982 through 1986. Annual modeling was conducted separately for each of the 5 years of meteorological data.

3.   Modeling Receptor Selection

Receptors were identified to ensure selection of downwind locations at which the highest concentrations would occur for both 1-hour concentrations predicted using PTPLU-2 and annual concentrations predicted using ISCLT.

3.1 PTPLU-2 Receptors

Because PTPLU-2 does not use actual meteorology, locations of the highest predicted concentrations are determined as relative distances from the source based on discrete wind speed and stability combinations (refer to Table 3). Predictions are first made at fixed distances downwind of the source. Then, from the location at which the highest downwind concentration is predicted, the distance to the maximum concentration is incrementally searched for and located to the nearest 1 meter.

3.2 ISCLT Receptors

The ISCLT receptor grid consisted of a polar coordinate grid and additional receptors located on the site property/fenceline. A total of 408 receptors were used in ISCLT modeling.

The polar coordinate receptor grid was based on the PTPLU-2 screening results.   The PTPLU-2 analysis using the input stack parameters presented in Table 2 identified distances to potential high-impact receptors as a function of the stability class/wind speed combinations

presented in Table 3. Receptor ring distances of 0.06, 0.09, 0.12, 0.14, 0.20, **0.25**, 0.30, 0.50, 1.0, 1.5, and 2.0 km were selected.

Each of the above 11 polar coordinate rings was divided into 10-degree sectors, yielding a total of 36 receptors per ring. Variation in terrain within the vicinity of each receptor was accounted for by using the highest terrain elevation in a nearly rectangular area surrounding that receptor. The area was bounded on either side by an arc length which was plus or minus 5 degrees of the actual receptor location. The top and bottom of the rectangular area was bounded by half the distance to the preceding and following polar receptor rings.

Table 4 identifies 12 additional discrete fenceline modeling receptor locations surrounding the proposed location of the soil venting system. These additional receptors were selected to provide an added measure of confidence that the area of greatest impact would be identified.

4.   Dispersion Modeling Results

Table 5 presents the maximum predicted 1-hour and annual concentrations for each **contaminant** listed in Table 1. The distance to the receptor predicted to have the maximum 1-hour concentration, based on PTPLU-2 modeling, is 120m from the source. The location at which the maximum annual predicted concentration occurs, based on ISCLT modeling, is located 200° (south-southwest) from the source at a distance of 140m.

5. Public Health Evaluation

Based on the modeling results, a public health evaluation (PHE) may be performed for the receptor groups which are likely to experience maximum exposures to airborne emissions from the soil venting system. The modeling results identified the downwind distance where maximum 1-hour concentrations would be expected, and the location where maximum annual concentrations would be expected. This PHE identifies the likely receptors associated with those locations, formulates worst-case exposure scenarios for the most-exposed receptors, and quantitatively estimates exposure levels and associated health risks for those exposure pathways.

5.1 Receptors

Based on the location where maximum short- and long-term air contaminant concentrations are predicted to occur, it is possible to identify two receptor groups which may experience maximum exposures to airborne contaminants. These groups are: (1) remediation workers in the immediate vicinity of the emissions source (i.e., the soil venting system) who would be the closest receptors and who might be exposed to short-term peak concentrations; and (2) off-site residents who might be exposed to lower concentrations for longer periods. To represent the first group, it is assumed that the most-exposed individual (MEI) would be an adult worker. The MEI for the second group is identified as a 6-year old child. The child is used because of his higher inhalation rate to body weight ratio, thus resulting in a maximum (worst-case) exposure

dosage estimate.   Selection of a child of this age is also related to the possibility that he might play in the area of the site, even though there are no residences in the immediate vicinity.   (The nearest residence is over 1 mile away.)   It was felt that younger children would not be likely to travel the distances necessary to get near the site.   The use of the 6-year old child therefore provides a worst-case estimate of exposure.

5.2 Exposure Assessment

Table 6 presents Threshold Limit Values (TLVs) for each contaminant of concern, and compares the values to maximum predicted 1-hour concentrations.   TLVs were developed by the American Conference of Governmental and Industrial Hygienists (ACGIH), [6] and are occupational exposure criteria that represent airborne concentrations of substances to which nearly all workers may be repeatedly exposed without adverse effects.   TLVs presented in Table 6 represent time-weighted average (TWA) concentrations to which individuals may be exposed during a normal 8-hour workday and 40-hour workweek without experiencing any adverse health effects.   TLVs are based on the best available information from industrial experience, as well as data from human and animal studies.   TLVs are used in industrial hygiene practice to control potential health hazards for workers.   TLVs are issued by the ACGIH, and are guidelines rather than enforceable standards.

Because the maximum predicted 1-hour concentrations are far below TLVs for long-term occupational exposure, it is concluded that there is no

danger of acute toxicity due to exposure to short-term peak emissions resulting from the soil venting system. The remainder of the PHE will, therefore, address only the potential for long-term health effects.

Table 7 presents assumptions used in the worker exposure scenario. As discussed previously, it is assumed that this worker is an adult male involved in work at the site. The period of exposure is estimated to be 540 days, i.e., the time during which soil venting is expected to take place. An inhalation rate of 2.8 m³/hour, corresponding to an adult male involved in moderate activity, [7] is used.

The assumptions listed in Table 7 are incorporated to calculate exposure dosages using the following equation:

$$IEX = AC \times IR \times D \times (1/1,000) \div BW \times EP \div 25,600$$

Where:

IEX	=	inhalation exposure dosage (mg/kg/day)
AC	=	airborne contaminant concentration (ug/m³)
IR	=	inhalation rate (m³/hour)
D	=	duration of daily exposure (hours/day)
1/1,000	=	conversion factor (mg/ug)
BW	=	body weight (kg)
EP	=	exposure period (days)
25,600	=	length of human lifetime (days)

Maximum annual average contaminant concentrations from Table 5 are used in this calculation as AC values to provide worst-case estimates of long-term exposure levels.

Table 8 presents assumptions used in the exposure scenario involving the 6-year old child. These assumptions are the same as used in the first scenario with the following exceptions. Because the receptor is a child, a different body weight (19.7 kg) and inhalation rate (2.1 m^3/hour) are used. [7], [8] In addition, the duration of an exposure period is assumed to be 4 hours/day rather than 8 hours/day. This value represents a reasonable worst-case average for this parameter because it is not likely that children will be playing near the site for extended periods due to the fact that the nearest residence is more than 1 mile away.

The same equation used previously is again used to calculate exposure estimates. Once again, maximum annual average contaminant concentrations from Table 5 are used in this calculation as AC values to provide worst-case estimates of long-term exposure levels.

5.3   Toxicity Assessment

Table 9 and 10 present human health criteria for inhalation exposure to the contaminants of interest. These values were obtained from USEPA Health Effects Assessment Summary Tables.[9]   For those

contaminants that are considered potential carcinogens, a Cancer Potency Factor (CPF) is presented. The CPF is expressed in units of inverse dosage, i.e., $(mg/kg/day)^{-1}$. Simply stated, it represents the increase in risk of cancer mortality per unit of exposure dosage. In most cases, CPFs are derived using data from animal experiments and by applying a low-dose extrapolation model that incorporates conservative assumptions concerning interspecies extrapolation.

For compounds not regarded as potential carcinogens, a Reference Dose (RfD), also called an Acceptable Intake for Chronic Exposure (AIC), is provided. This value represents the exposure dosage in mg/kg/day which, if consumed daily throughout a person's lifetime, would not result in any adverse health effects. USEPA usually derives RfDs based on animal data which define a no-effect dosage or threshold for toxicity. This threshold value is divided by a conservative safety factor, typically 100 or 1,000, to derive a human RfD. These RfD values may then be used to determine a Hazard Index (HI) for given exposures. The HI is the ratio of the estimated exposure level to the RfD value. HI values greater than 1.0 may indicate a potential health risk.

As shown in Tables 9 and 10, not all of the compounds of interest have toxicity criteria available. As a result, they cannot be evaluated quantitatively and are not included in subsequent risk estimates. This should be considered as an area of uncertainty in the PHE.

The approach used to characterize risk in this section is analogous to the methods used in the original baseline RI risk assessment conducted by IT Corporation.

5.4   Risk Characterization

This section describes the potential risks associated with estimated exposure levels calculated as described previously.

For the adult worker exposure scenario, estimated incremental lifetime cancer risks and hazard indices are presented in Table 9. As shown in this table, the total estimated cancer risk associated with exposure to maximum concentrations of all of the chemicals of interest is 1.5×10^{-10} under the conditions of this scenario. The total HI for non-carcinogenic effects is 1.7×10^{-9}, which is far below the 1.0 value which indicates a potential hazard.

For the childhood exposure scenario, estimated incremental cancer risks and hazard indices are presented in Table 10. As shown in this table, the total estimated cancer risk associated with exposure to maximum concentrations of all contaminants of interest is 2.1×10^{-10}. The total HI for non-carcinogenic effects is 2.3×10^{-9}, which is far below the 1.0 HI which indicates a potential hazard.

6.   References

(1)   United States Environmental Protection Agency, <u>Screening Procedures For Estimating the Air Quality Impact of Stationary Sources (Draft)</u>, EPA-450/4-88-010, August 1988.

(2)   United States Environmental Protection Agency, <u>Guideline on Air Quality Models (Revised)</u>, EPA-450/2-78-027, July 1986.

(3)   Auer, A.H., <u>Correlation of Land and Cover With Meteorological Anomalies</u>, Journal of Applied Meteorology, 17, 1978, pp. 636-643.

(4)   40 CFR 51, Stack Height Regulations: Final Rule, 1985.

(5)   United States Environmental Protection Agency, Office of Solid Waste, <u>Guidance on Metals and Hydrogen Chloride Controls for Hazardous Waste Incinerator (Draft)</u>, March 1989.

(6)   American Conference of Governmental and Industrial Hygienists, <u>Threshold Limit Values and Biological Exposure Indices for 1989-1990</u>, 1989.

(7)   United States Environmental Protection Agency, <u>Superfund Exposure Assessment Manual, OSWER Directive 9285.5-1</u>, EPA 540/1-88/001, 1988.

(8)   United States Environmental Protection Agency, <u>Exposure Factors Handbook</u>, EPA/600/8-89/043, 1989.

4 9   0296

(9)   United States Environmental Protection Agency, Health Effects Summary of Tables, OERR, 9200.6-303-(89-2), 1989.

FIGURE 1

4 9   0297

Zion Chapel No. 2
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BM 140

x/33

/32

SITE

x/35

QUADRANGLE LOCATION

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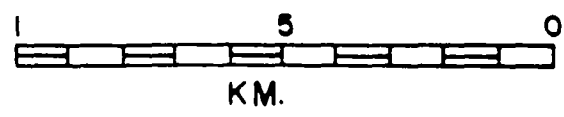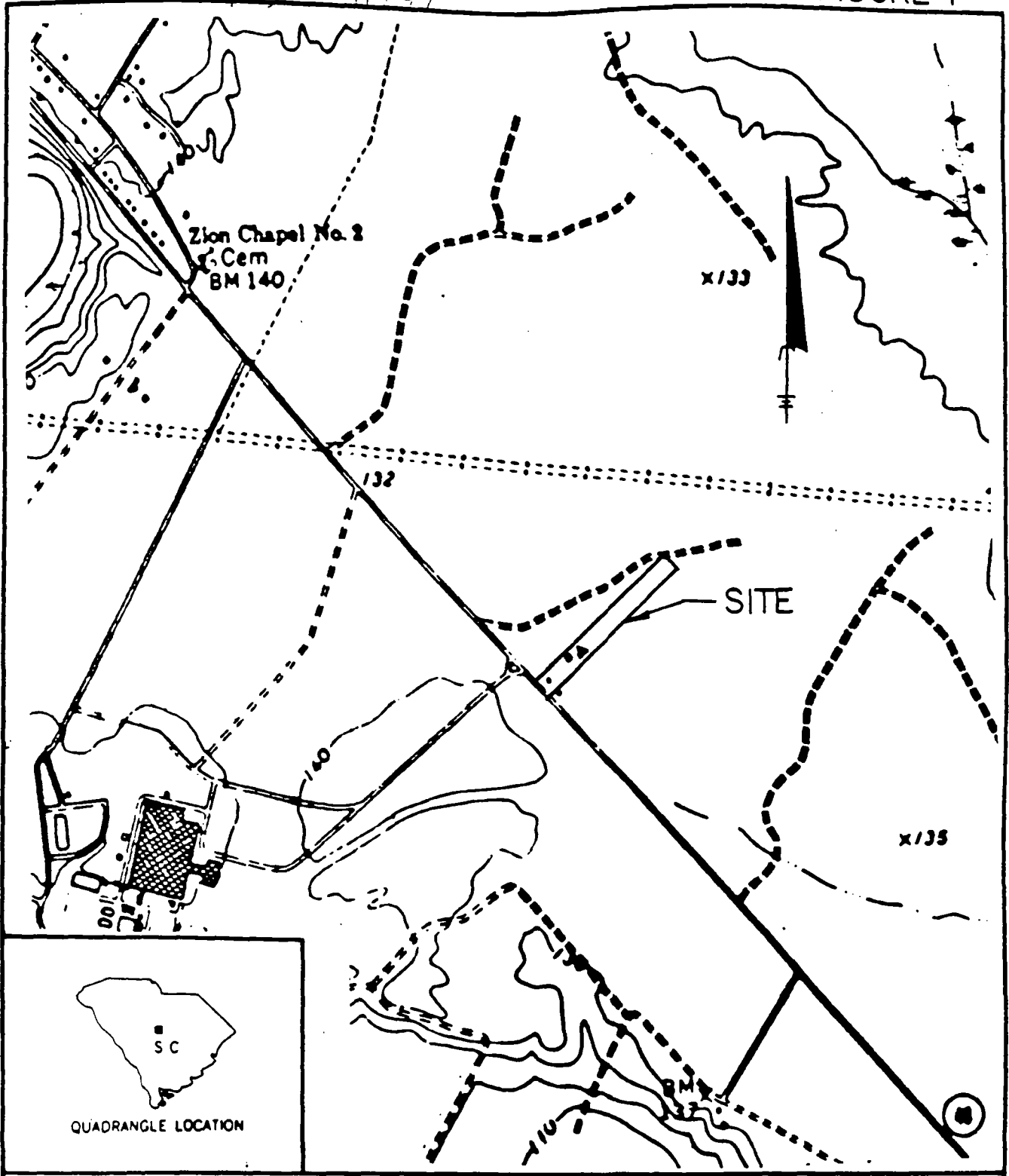
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▲ PROPOSED LOCATION OF
SOIL VENTING SYSTEM

SITE LOCATION MAP
SCRDI BLUFF ROAD SITE

BLASLAND & BOUCK
ENGINEERS, P.C.

546.02.20

TABLE 1
SCRDI-BLUFF ROAD SITE
ESTIMATED SOIL VENTING EMISSIONS

ANALYTE	MAXIMUM SOIL CONC PPM	VENDOR EST. TIME DURATION MONTHS	MAXIMUM IN 45000 CU YDS LBS	ASSUMED GAS FLOW RATE CFM	CONTAM. MASS LB/HR	g/SEC W/O CONTROL EMISSIONS 100%	g/sec EMISSIONS W/CONTROL	STACK DIAM INCHES	STACK HEIGHT ft	EXIT VELOCITY m/sec
CARBON TETRACHLORIDE	4.1	18	2.005466	750	0.000154	0.000019	1.95E-08	6	30	19.40418
ACETONE	160		78.26209	750	0.006038	0.000761	7.62E-07			
CHLOROFORM	10		4.891380	750	0.000377	0.000047	4.76E-08			
1,1,1-TRICHLOROETHANE	14		6.847933	750	0.000528	0.000066	6.66E-08			
METHYLENE CHLORIDE	39		19.07838	750	0.001471	0.000185	1.86E-07			
1,1-DICHLOROETHANE	0.39		0.190763	750	0.000014	0.000001	1.86E-09			
2-BUTANONE (MEK)	89		43.53929	750	0.003359	0.000423	4.24E-07			
TRICHLOROETHENE	44		21.52207	750	0.001660	0.000209	2.09E-07			
1,1,2,2-TETRACHLOROETHANE	2300		1125.017	750	0.086806	0.010947	1.09E-05			
ETHYL BENZENE	18		8.804485	750	0.000679	0.000085	8.57E-08			
4-METHYL-2-PENTANONE (MIBK)	0.34		0.166306	750	0.000012	0.000001	1.62E-09			
TOLUENE	340		166.3069	750	0.012832	0.001618	1.62E-06			
CHLOROBENZENE	23		11.25017	750	0.000868	0.000109	1.09E-07			
TETRACHLOROETHENE	95		46.46811	750	0.003585	0.000452	4.52E-07			
1,2-DICHLOROETHENE	0.045		0.022011	750	0.000001	0.000000	2.14E-10			
XYLENES	62		30.32656	750	0.002340	0.000295	2.95E-07			
1,1-DICHLOROETHENE	0.24		0.117393	750	0.000009	0.000001	1.14E-09			
BENZENE	0.59		0.288591	750	0.000022	0.000002	2.81E-09			
1,2-DICHLOROETHANE	0.12		0.058696	750	0.000004	0.000000	5.71E-10			
2-CHLOROPHENOL	2000		978.2761	750	0.075484	0.009519	9.52E-06			
PHENOL	6300		3081.569	750	0.237775	0.029986	3.00E-05			
	11499.82		5625.002		0.434027	0.054735	0.000054			

*TOTAL SOIL VOLATILE CONTENT ESTIMATED FROM VENDOR DATA
OF 2000 LBS IN 16,000 CU YDS (AREA OF HIGHEST CONTAM.).
ASSUME SAME LOADING THROUGHOUT THE ESTIMATED 45,000 CU YDS
TO ESTABLISH WORST CASE.

TABLE 2

DESIGN STACK PARAMETERS FOR TREATMENT OF SOIL USING SOIL VENTING

UTM Coordinates (km)		Stack Base Elevation (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Flow Rate (ACFM)	Exhaust Velocity (m/s)	Exhaust Gas Exit Temp. (°K)
Easting	Northing						
508.433	3749.341	41.76	9.14	0.152	750	19.40	293.15

TABLE 3

METEOROLOGICAL CONDITIONS USED FOR THE
PTPLU-2 SCREENING ANALYSIS

Stability Class	Wind Speed (m/s)
A	0.5, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0
B	0.5, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0
C	2.0, 2.5, 3.0, 4.0, 5.0, 7.0, 10.0, 12.0, 15.0
D	0.5, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.0, 10.0, 12.0, 15.0, 20.0
E	2.0, 2.5, 3.0, 4.0, 5.0
F	2.0, 2.5, 3.0, 4.0, 5.0

Note: The wind is assumed to be blowing directly from the source to the receptor.

TABLE 4

LOCATIONS OF DISCRETE FENCELINE MODELING RECEPTORS

UTM Coordinates (km)		Elevation	
Easting	Northing	Meters	Feet
508.340	3749.310	42.06	138
508.417	3749.374	42.06	138
508.494	3749.438	41.76	137
508.571	3749.502	41.76	137
508.648	3749.566	41.45	136
508.680	3749.593	41.45	136
508.703	3749.565	41.45	136
508.671	3749.538	41.45	136
508.594	3749.474	41.76	137
508.517	3749.410	41.76	137
508.440	3749.346	42.06	138
508.363	3749.282	42.06	138

TABLE 5

MAXIMUM PREDICTED
1-HOUR AND ANNUAL CONCENTRATIONS
FOR TREATMENT OF SOIL USING SOIL VENTING

Contaminant	Maximum Concentration (ug/m^3)	
Volatiles	1-Hour	Annual
Acetone	3.09×10^{-4}	7.99×10^{-6}
Chloroform	1.93×10^{-5}	4.99×10^{-7}
1,1,1-Trichloroethane	2.70×10^{-5}	6.99×10^{-7}
Methylene Chloride	7.53×10^{-5}	1.95×10^{-6}
1,1-Dichloroethane	7.53×10^{-7}	1.95×10^{-8}
2-Butanone	1.72×10^{-4}	4.45×10^{-6}
Trichloroethene	8.46×10^{-5}	2.19×10^{-6}
1,1,2,2-Tetrachloroethane	4.41×10^{-3}	1.14×10^{-4}
Ethylbenzene	3.47×10^{-5}	8.99×10^{-7}
Toluene	6.56×10^{-4}	1.70×10^{-5}
Chlorobenzene	4.41×10^{-5}	1.14×10^{-6}
Tetrachloroethene	1.83×10^{-4}	4.74×10^{-6}
1,2-Dichloroethene	8.67×10^{-8}	2.24×10^{-9}
Xylenes	1.19×10^{-4}	3.09×10^{-6}
1,1-Dichloroethene	4.62×10^{-7}	1.20×10^{-8}
Benzene	1.14×10^{-6}	2.95×10^{-8}
1,2-Dichloroethane	2.31×10^{-7}	5.99×10^{-9}
Carbon Tetrachloride	7.90×10^{-6}	2.05×10^{-7}
Methyl Isobutyl Ketone	6.56×10^{-7}	1.70×10^{-8}
Semivolatiles		
2-Chlorophenol	3.85×10^{-3}	9.99×10^{-5}
Phenol	1.21×10^{-2}	3.15×10^{-4}

TABLE 6

THRESHOLD LIMIT VALUES
FOR SOIL VENTING EMISSIONS

Contaminant	Maximum[1] 1-Hour Concentration (ug/m^3)	Threshold[2] Limit Values Time Weighted Averages (ug/m^3)
Volatiles		
Acetone	3.09×10^{-4}	1.78×10^6
Chloroform	1.93×10^{-5}	4.90×10^4
1,1,1-Trichloroethane	2.70×10^{-5}	1.91×10^6
Methylene Chloride	7.53×10^{-5}	1.74×10^5
1,1-Dichloroethane	7.53×10^{-7}	8.10×10^5
2-Butanone	1.72×10^{-4}	5.90×10^5
Trichloroethene	8.46×10^{-5}	2.69×10^5
1,1,2,2-Tetrachloroethane	4.41×10^{-3}	6.90×10^3
Ethylbenzene	3.47×10^{-5}	4.34×10^5
Toluene	6.56×10^{-4}	3.77×10^5
Chlorobenzene	4.41×10^{-5}	4.60×10^4
Tetrachloroethene	1.83×10^{-4}	3.39×10^5
1,2-Dichloroethene	8.67×10^{-8}	3.47×10^5
Xylenes	1.19×10^{-4}	4.34×10^5
1,1-Dichloroethene	4.62×10^{-7}	2.00×10^4
Benzene	1.14×10^{-6}	3.20×10^4
1,2-Dichloroethane	2.31×10^{-7}	4.00×10^4
Carbon Tetrachloride	7.90×10^{-6}	3.10×10^4
Methyl Isobutyl Ketone	6.56×10^{-7}	2.05×10^5
Semivolatiles		
2-Chlorophenol	3.85×10^{-3}	
Phenol	1.21×10^{-2}	1.90×10^4

Notes:

[1] Values derived from air modeling described previously.
[2] TLV-TWA represents an exposure for an 8-hour day/40-hour work week, which results in no adverse effects. [6]

TABLE 7

EXPOSURE SCENARIO FOR WORKER
INHALATION OF AIRBORNE CONTAMINANTS FROM
SOIL VENTING EMISSIONS

Receptors:	On-site workers
Adult or Child:	Adult
Male/Female:	Male
Activity Level:	Moderate
Frequency of Event:	540 days (18 months)
Duration of Event:	8 hours/day
Inhalation Rate:	2.8 m^3/hour [7]
Weight:	70 kg [8]

Potential Exposure Pathways Considered Significant:

<u>Inhalation of Ambient Air</u>

Compounds: All site-specific chemicals.

Data Sets: Maximum annual concentrations
predicted from modeling soil venting
emissions.

TABLE   8

EXPOSURE SCENARIO FOR 6-YEAR OLD CHILD AT OFF-SITE AREA
INHALATION OF AIRBORNE CONTAMINANTS FROM
SOIL VENTING EMISSIONS

Receptors: 6-year old child
Adult or Child: Child
Male/Female: Male
Activity Level: Moderate activity
Frequency of Event: 540 days (18 months)
Duration of Event: 4 hours/day
Inhalation Rate: 2.1 m^3/hour [7]
Weight: 19.7 kg [8]

Potential Exposure Pathways Considered Significant:

Inhalation of Ambient Air

Compounds: All site-specific chemicals.

Data Sets: Maximum   annual   concentrations
                                        predicted from modeling soil venting
                                        emissions.

TABLE 9

RISK CALCULATIONS FOR WORKERS
INHALATION OF AIRBORNE CONTAMINANTS
FROM SOIL VENTING EMISSIONS

Contaminant	Maximum Annual Air Concent. $(\mu g/m^3)$	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RfD (mg/kg/day)	Risk	Hazard Index
Volatiles						
Acetone	7.99×10^{-6}	5.4×10^{-11}				
Chloroform	4.99×10^{-7}	3.4×10^{-12}	8.1×10^{-2}		2.7×10^{-13}	
1,1,1-Trichloroethane	6.99×10^{-7}	4.7×10^{-12}		3.0×10^{-1}		1.6×10^{-11}
Methylene Chloride	1.95×10^{-6}	1.3×10^{-11}	1.4×10^{-2}		1.9×10^{-13}	
1,1-Dichloroethane	1.95×10^{-8}	1.3×10^{-13}		1.0×10^{-1}		1.3×10^{-12}
2-Butanone	4.45×10^{-6}	3.0×10^{-11}				
Trichloroethene	2.19×10^{-6}	1.5×10^{-11}	1.3×10^{-2}		1.9×10^{-13}	
1,1,2,2-Tetrachloroethane	1.14×10^{-4}	7.7×10^{-10}	2.0×10^{-1}		1.5×10^{-10}	
Ethylbenzene	8.99×10^{-7}	6.1×10^{-12}				
Toluene	1.70×10^{-5}	1.1×10^{-10}		1.0		1.1×10^{-10}
Chlorobenzene	1.14×10^{-6}	7.7×10^{-12}		5.0×10^{-3}		1.5×10^{-9}
Tetrachloroethene	4.74×10^{-6}	3.2×10^{-11}	3.3×10^{-3}		1.1×10^{-13}	
1,2-Dichloroethene	2.24×10^{-9}	1.5×10^{-14}				
Xylenes	3.09×10^{-6}	2.1×10^{-11}		4.0×10^{-1}		5.2×10^{-11}
1,1-Dichloroethene	1.20×10^{-8}	8.1×10^{-14}	1.2		9.7×10^{-14}	
Benzene	2.95×10^{-8}	2.0×10^{-13}	2.9×10^{-2}		5.8×10^{-15}	
1,2-Dichloroethane	5.99×10^{-9}	4.0×10^{-14}	9.1×10^{-2}		3.7×10^{-15}	
Carbon Tetrachloride	2.05×10^{-7}	1.4×10^{-12}	1.3×10^{-1}		1.8×10^{-13}	
Methyl Isobutyl Ketone	1.70×10^{-8}	1.1×10^{-13}		2.0×10^{-2}		5.7×10^{-12}

TABLE 9 (Cont'd.)

RISK CALCULATIONS FOR WORKERS
INHALATION OF AIRBORNE CONTAMINANTS
FROM SOIL VENTING EMISSIONS

Contaminant	Maximum Annual Air Concent. (ug/m^3)	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RID (mg/kg/day)	Risk	Hazard Index
Semivolatiles						
2-Chlorophenol	9.99×10^{-5}	6.4×10^{-11}				
Phenol	3.15×10^{-4}	2.0×10^{-10}				
				TOTAL:	1.5×10^{-10}	1.7×10^{-9}

TABLE 10

RISK CALCULATIONS FOR 6-YEAR OLD CHILD
INHALATION OF AIRBORNE CONTAMINANTS
FROM SOIL VENTING EMISSIONS

Contaminant	Maximum Annual Air Concent. $(\mu g/m^3)$	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RfD (mg/kg/day)	Risk	Hazard Index
Volatiles						
Acetone	7.99×10^{-6}	7.2×10^{-11}				
Chloroform	4.99×10^{-7}	4.5×10^{-12}	8.1×10^{-2}		3.6×10^{-13}	
1,1,1-Trichloroethane	6.99×10^{-7}	6.3×10^{-12}		3.0×10^{-1}		2.1×10^{-11}
Methylene Chloride	1.95×10^{-6}	1.8×10^{-11}	1.4×10^{-2}		2.5×10^{-13}	
1,1-Dichloroethane	1.95×10^{-8}	1.8×10^{-13}		1.0×10^{-1}		1.8×10^{-12}
2-Butanone	4.45×10^{-6}	4.0×10^{-11}				
Trichloroethene	2.19×10^{-6}	2.0×10^{-11}	1.3×10^{-2}		2.6×10^{-13}	
1,1,2,2-Tetrachloroethane	1.14×10^{-4}	1.0×10^{-9}	2.0×10^{-1}		2.1×10^{-10}	
Ethylbenzene	8.99×10^{-7}	8.1×10^{-12}				
Toluene	1.70×10^{-5}	1.5×10^{-10}		1.0		1.5×10^{-10}
Chlorobenzene	1.14×10^{-6}	1.0×10^{-11}		5.0×10^{-3}		2.1×10^{-9}
Tetrachloroethene	4.74×10^{-6}	4.3×10^{-11}	3.3×10^{-3}		1.4×10^{-13}	
1,2-Dichloroethene	2.24×10^{-9}	2.0×10^{-14}				
Xylenes	3.09×10^{-6}	2.8×10^{-11}		4.0×10^{-1}		6.9×10^{-11}
1,1-Dichloroethene	1.20×10^{-8}	1.1×10^{-13}	1.2		1.3×10^{-13}	
Benzene	2.95×10^{-8}	2.7×10^{-13}	2.9×10^{-2}		7.7×10^{-15}	
1,2-Dichloroethane	5.99×10^{-9}	5.4×10^{-14}	9.1×10^{-2}		4.9×10^{-15}	
Carbon Tetrachloride	2.05×10^{-7}	1.8×10^{-12}	1.3×10^{-1}		2.4×10^{-13}	
Methyl Isobutyl Ketone	1.70×10^{-8}	1.5×10^{-13}		2.0×10^{-2}		7.6×10^{-12}

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TABLE 10 (Cont'd.)

RISK CALCULATIONS FOR 6-YEAR OLD CHILD
INHALATION OF AIRBORNE CONTAMINANTS
FROM SOIL VENTING EMISSIONS

Contaminant	Maximum Annual Air Concent. (ug/m^3)	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RfD (mg/kg/day)	Risk	Hazard Index
Semivolatiles						
2-Chlorophenol	9.99×10^{-5}	8.6×10^{-11}				
Phenol	3.15×10^{-4}	2.7×10^{-10}				
				TOTAL:	2.1×10^{-10}	2.3×10^{-9}

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APPENDIX F

AIR QUALITY IMPACT ANALYSIS AND PUBLIC HEALTH EVALUATION FOR TREATMENT OF SOIL USING INCINERATION AT THE SCRDI BLUFF ROAD SITE

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An evaluation to assess the health effects associated with air emissions from the on-site treatment of soil using incineration at the SCRDI Bluff Road site is presented in this document. Air quality dispersion modeling was performed to predict maximum ambient air impacts to support this evaluation. Long-term modeling was conducted to determine maximum annual impacts using 5 years of regional National Weather Service (NWS) meteorological data. Short-term impacts were evaluated using a screening model to estimate the maximum 1-hour concentrations based on a worst-case combination of atmospheric stability and wind speed.

Section 1 discusses the dispersion modeling techniques employed. Section 2 presents the input data used. Section 3 describes the procedure for modeling receptor selection. Section 4 presents the dispersion modeling results. Section 5 presents the public health evaluation.

1. Dispersion Modeling Techniques

Both screening and refined modeling were conducted as part of the air quality dispersion analysis. For short-term impacts (24 hours or less), the United States Environmental Protection Agency (USEPA) recommends use of a screening model to estimate conservative short-term impacts for pollutants released from a stationary source.[1] If, based on appropriate screening techniques, the concentration of a pollutant is predicted below an acceptable health-based level, no further modeling of the pollutant is required due to the

conservative nature of the prediction. If, on the other hand, the predicted concentration is above this acceptable health-based level, a refined modeling analysis is necessary to predict the short-term maximum concentration.

USEPA recommendations contained in <u>Guideline on Air Quality Models (Revised)</u>[2] were used to select the appropriate dispersion models. Three factors were considered:

a. Whether the area is classified as urban or non-urban according to USEPA modeling protocols;

b. Whether it is necessary to consider plume impact upon complex terrain; and

c. Whether it is necessary to consider building-induced aerodynamic downwash effects.

Figure 1 presents a site location map depicting the site boundary and surrounding area. The area surrounding the site is non-urban based on recommended USEPA classification procedures. The recommended method is to apply the Auer Classification Scheme[3] to classify land use patterns within 3 km of a site. United States Geological Survey (USGS) topographic maps for the site and vicinity clearly indicate that the area is non-urban; therefore modeling was conducted in the non-urban or rural mode.

The proposed stack height and results of the screening modeling are used to determine whether plume impact upon complex terrain need be considered. Preliminary screening modeling results based on a proposed stack height of 60 feet indicated that maximum impacts (discussed further in Section 4) would occur well within 4.7 kilometers of the source. The area surrounding the site (within 4.7 km) has terrain elevations ranging from 60 feet above to 27 feet below stack base elevation. However, the elevations approaching stack height occur in an isolated area beyond 4.5 km north-northeast of the site, with all other areas having elevations less than 50 feet above stack base. In accordance with USEPA guidance,[2] it is not necessary to consider plume impact upon terrain; therefore, a simple terrain model was used.

Finally, as designed, the incinerator will achieve a Good Engineering Practice (GEP) stack height based on nearby and/or adjacent building geometry.[4] As such, it was not necessary to model aerodynamic building-induced downwash effects.

Based on the above considerations, the Industrial Source Complex Long-Term (ISCLT) model was used to predict annual concentrations, and the Point-Plume-2 (PTPLU-2) model was used to predict maximum 1-hour concentrations. Results using the PTPLU-2 model were also employed to select receptors for use in modeling with ISCLT model. Options used in ISCLT and PTPLU-2 are consistent with USEPA guidance.[2] For both models, the options selected included the adjustment of the stack height for stack tip downwash, determination of final plume rise for all downwind receptor locations, determination of plume enhancement due to buoyancy effects, and use of rural-mode wind profile coefficients.

2. Input Data Used

The dispersion modeling analysis to evaluate air quality impacts from on-site incineration required development and input of a detailed emissions inventory, and assembly and input of representative meteorological data. Each of these two areas is discussed below.

2.1 Emissions Inventory

Table 1 presents stack emission rates and associated input data. Table 2 presents design stack parameters. Data presented in these two tables are based on the processing of 20 tons of soil per hour.

Based on vendor input, the stack flow for a transportable rotary kiln treating 20 tons per hour (TPH) of low-BTU soil would be about 60,000 ACFM at 186°F. The vendor system includes a fabric filter for particulate control and a wet scrubber for acid gas removal. In order to estimate the stack concentrations, the maximum soil concentration of each organic was assumed to be the average value. These values are shown in Table 1 for volatiles, semivolatiles, and metals. It was assumed that 100 percent of the organics would be vaporized from the soil, that 99.99 percent of each organic would be destroyed in the rotary kiln and secondary combustion chamber, and that none of the remaining 0.01 percent of each organic would be removed in the fabric filter or the wet scrubber. As an example, the calculations for the acetone stack

flow rate (SFR), based on these assumptions, would be as follows:

$$\text{SFR (g/s)} = \frac{20 \text{ tons}}{\text{hr}} \times \frac{2,000 \text{ lb}}{\text{ton}} \times \frac{160,000}{10^9} \times 0.0001 \times \frac{453.6 \text{ g/lb}}{3,600 \text{ s/hr}}$$

$$= 8.06 \times 10^{-5} \text{ g/s}$$

The following ten metals were used in determining the stack emissions and were taken from Volume IV of the Hazardous Waste Incineration Guidance Series.[5]

Antimony	Chromium
Arsenic	Lead
Barium	Mercury
Beryllium	Silver
Cadmium	Thallium

In order to estimate the stack concentration, the maximum soil concentration of each metal was assumed to be the average value. These values are also shown in Table 1. The partitioning factor for each metal and the air pollution control (APC) removal efficiency given in this table were taken from the metals guidance document. The basis for the partitioning factor estimate was 1600°F soil. A partitioning factor of 1.0 indicates that the particular metal will vaporize completely in the rotary kiln. A partitioning factor of 0.05 means that 5 percent of the particular metal will vaporize and/or be entrained in the rotary kiln combustion gas. An APC removal efficiency of 90 percent means that

90 percent of the particular metal will be removed in the APC system which is a fabric filter and a wet scrubber.

As an example, the calculations for the antimony stack flow rate would be as follows:

$$\text{SFR (g/s)} = \frac{20\ \text{ton}}{\text{hr}} \times \frac{2000\ \text{lb}}{\text{ton}} \times \frac{6}{10^6} \times 1.0 \times (1\text{-}0.9) \times \frac{453.6\ \text{g/lb}}{3600\ \text{s/hr}}$$

$$= 3.02 \times 10^{-3}\ \text{g/s}$$

2.2 Meteorological Data

Representative meteorology was used in the screening modeling using PTPLU-2 and refined modeling using ISCLT.

Table 3 presents the meteorological conditions used for the PTPLU-2 screening analysis. PTPLU-2 predicts the maximum downwind concentrations based on discrete combinations of stability class and wind speed, and does not require actual meteorology representative of the source location.

The ISCLT model employed 5 years of annual stability array (STAR) data based on hourly observations from the NWS station in Columbia, South Carolina. The data provides annual joint frequencies of stability versus wind speed and wind direction. The period of record employed was the years 1982 through 1986. Annual modeling was conducted separately for each of the 5 years of meteorological data.

3. Modeling Receptor Selection

Receptors were identified to ensure selection of downwind locations at which the highest concentrations would occur for both 1-hour concentrations predicted using PTPLU-2 and annual concentrations predicted using ISCLT.

3.1 PTPLU-2 Receptors

Because PTPLU-2 does not use actual meteorology, locations of the highest predicted concentrations are determined as relative distances from the source based on discrete wind speed and stability combinations (refer to Table 3). Predictions are first made at fixed distances downwind of the source. Then, from the location at which the highest downwind concentration is predicted, the distance to the maximum concentration is incrementally searched for and located to the nearest 1 meter.

3.2 ISCLT Receptors

The ISCLT receptor grid consisted of a polar coordinate grid and additional receptors located on the site property/fenceline. A total of 408 receptors were used in ISCLT modeling.

The polar coordinate receptor grid was based on the PTPLU-2 screening results. The PTPLU-2 analysis using the input stack parameters presented in Table 2 identified distances to potential high-impact

receptors as a function of the stability class/wind speed combinations presented in Table 3. Receptor ring distances of 0.29, 0.35, 0.45, 0.55, 0.65, 0.85, 1.0, 2.0, 2.7, 3.2, and 4.7 km were selected.

Each of the above 11 polar coordinate rings was divided into 10-degree sectors, yielding a total of 36 receptors per ring. Variation in terrain within the vicinity of each receptor was accounted for by using the highest terrain elevation in a nearly rectangular area surrounding that receptor. The area was bounded on either side by an arc length which was plus or minus 5 degrees of the actual receptor location. The top and bottom of the rectangular area was bounded by half the distance to the preceding and following polar receptor rings.

Table 4 identifies 12 additional discrete fenceline modeling receptor locations surrounding the proposed incinerator location. These additional receptors were selected to provide an added measure of confidence that the area of greatest impact would be identified.

4.   Dispersion Modeling Results

Table 5 presents the maximum predicted 1-hour and annual concentrations for each contaminant listed in Table 1. The distance to the receptor predicted to have the maximum 1-hour concentration, based on PTPLU-2 modeling, is 280m from the source. The location at which the maximum annual predicted concentration occurs, based on ISCLT modeling, is located 200° (south-southwest) from the source at a distance of 850m.

5.   Public Health Evaluation

Based on the modeling results, a public health evaluation (PHE) may be performed for the receptor groups which are likely to experience maximum exposures to airborne incinerator emissions. The modeling results identified the downwind distance where maximum 1-hour concentrations would be expected, and the location where maximum annual concentrations would be expected. This PHE identifies the likely receptors associated with those locations, formulates worst-case exposure scenarios for the most-exposed receptors, and quantitatively estimates exposure levels and associated health risks for those exposure pathways.

5.1 Receptors

Based on the location where maximum short- and long-term air contaminant concentrations are predicted to occur, it is possible to identify two receptor groups which may experience maximum exposures to airborne contaminants. These groups are: (1) remediation workers in the immediate vicinity of the emissions source (i.e., the incinerator) who would be the closest receptors and who might be exposed to short-term peak concentrations; and (2) off-site residents who might be exposed to lower concentrations for longer periods. To represent the first group, it is assumed that the most-exposed individual (MEI) would be an adult worker. The MEI for the second group is identified as a 6-year old child. The child is used because of his higher inhalation rate

to body weight ratio, thus resulting in a maximum (worst-case) exposure dosage estimate. Selection of a child of this age is also related to the possibility that he might play in the area of the site, even though there are no residences in the immediate vicinity. (The nearest residence is over 1 mile away.) It was felt that younger children would not be likely to travel the distances necessary to get near the site. The use of the 6-year old child therefore provides a worst-case estimate of exposure.

5.2 Exposure Assessment

Table 6 presents Threshold Limit Values (TLVs) for each contaminant of concern, and compares the values to maximum predicted 1-hour concentrations. TLVs were developed by the American Conference of Governmental and Industrial Hygienists (ACGIH), [6] and are occupational exposure criteria that represent airborne concentrations of substances to which nearly all workers may be repeatedly exposed without adverse effects. TLVs presented in Table 6 represent time-weighted average (TWA) concentrations to which individuals may be exposed during a normal 8-hour workday and 40-hour workweek without experiencing any adverse health effects. TLVs are based on the best available information from industrial experience, as well as data from human and animal studies. TLVs are used in industrial hygiene practice to control potential health hazards for workers. TLVs are issued by the ACGIH, and are guidelines rather than enforceable standards.

Because the maximum predicted 1-hour concentrations are far below TLVs for long-term occupational exposure, it is concluded that there is no danger of acute toxicity due to exposure to short-term peak incinerator emissions. The remainder of the PHE will, therefore, address only the potential for long-term health effects.

Table 7 presents assumptions used in the worker exposure scenario. As discussed previously, it is assumed that this worker is an adult male involved in work at the site. The period of exposure is estimated to be 200 days, i.e., the time during which the incinerator is expected to be operating. An inhalation rate of 2.8 m³/hour, corresponding to an adult male involved in moderate activity, [7] is used.

The assumptions listed in Table 7 are incorporated to calculate exposure dosages using the following equation:

$$IEX = AC \times IR \times D \times (1/1,000) \div BW \times EP \div 25,600$$

Where:

IEX	=	inhalation exposure dosage (mg/kg/day)
AC	=	airborne contaminant concentration (ug/m³)
IR	=	inhalation rate (m³/hour)
D	=	duration of daily exposure (hours/day)
1/1,000	=	conversion factor (mg/ug)
BW	=	body weight (kg)

EP   =   exposure period (days)

25,600   =   length of human lifetime (days)

Maximum annual average contaminant concentrations from Table 5 are used in this calculation as AC values to provide worst-case estimates of long-term exposure levels.

Table 8 presents assumptions used in the exposure scenario involving the 6-year old child. These assumptions are the same as used in the first scenario with the following exceptions. Because the receptor is a child, a different body weight (19.7 kg) and inhalation rate (2.1 m^3/hour) are used. [7], [8] In addition, the duration of an exposure period is assumed to be 4 hours/day rather than 8 hours/day. This value represents a reasonable worst-case average for this parameter because it is not likely that children will be playing near the site for extended periods due to the fact that the nearest residence is more than 1 mile away.

The same equation used previously is again used to calculate exposure estimates.   Once again, maximum annual average contaminant concentrations from Table 5 are used in this calculation as AC values to provide worst-case estimates of long-term exposure levels.

5.3   Toxicity Assessment

Table 9 and 10 present human health criteria for inhalation exposure to the contaminants of interest. These values were obtained from USEPA Health Effects Assessment Summary Tables. [9] For those contaminants that are considered potential carcinogens, a Cancer Potency Factor (CPF) is presented. The CPF is expressed in units of inverse dosage, i.e., $(mg/kg/day)^{-1}$. Simply stated, it represents the increase in risk of cancer mortality per unit of exposure dosage. In most cases, CPFs are derived using data from animal experiments and by applying a low-dose extrapolation model that incorporates conservative assumptions concerning interspecies extrapolation.

For compounds not regarded as potential carcinogens, a Reference Dose (RfD), also called an Acceptable Intake for Chronic Exposure (AIC), is provided. This value represents the exposure dosage in mg/kg/day which, if consumed daily throughout a person's lifetime, would not result in any adverse health effects. USEPA usually derives RfDs based on animal data which define a no-effect dosage or threshold for toxicity. This threshold value is divided by a conservative safety factor, typically 100 or 1,000, to derive a human RfD. These RfD values may then be used to determine a Hazard Index (HI) for given exposures. The HI is the ratio of the estimated exposure level to the RfD value. HI values greater than 1.0 may indicate a potential health risk.

For chromium, toxicity values for both hexavalent and trivalent chromium are presented. Because emission estimates are expressed as total chromium, cancer risks will be estimated assuming that all of the chromium present is hexavalent, the more toxic form.

As shown in Tables 9 and 10, not all of the compounds of interest have toxicity criteria available. As a result, they cannot be evaluated quantitatively and are not included in subsequent risk estimates. This should be considered as an area of uncertainty in the PHE.

The approach used to characterize risk in this section is analogous to the methods used in the original baseline RI risk assessment conducted by IT Corporation.

5.4   Risk Characterization

This section describes the potential risks associated with estimated exposure levels calculated as described previously.

For the adult worker exposure scenario, estimated incremental lifetime cancer risks and hazard indices are presented in Table 9. As shown in this table, the total estimated cancer risk associated with exposure to maximum concentrations of all of the chemicals of interest is 1.7×10^{-7} under the conditions of this scenario. The compound which contributes the major portion of this total risk is arsenic (1.4×10^{-7}). The total HI for non-carcinogenic effects is 4.9×10^{-4}, which is far below the 1.0 value which indicates a potential hazard.

For the childhood exposure scenario, estimated incremental cancer risks and hazard indices are presented in Table 10. As shown in this table, the total estimated cancer risk associated with exposure to maximum concentrations of all contaminants of interest is 2.2×10^{-7}. The principal contributor to this total risk level is arsenic (1.8×10^{-7}). The total HI for non-carcinogenic effects is 6.6×10^{-4}, which is far below the 1.0 HI which indicates a potential hazard.

6. References

(1) United States Environmental Protection Agency, <u>Screening Procedures For Estimating the Air Quality Impact of Stationary Sources (Draft)</u>, EPA-450/4-88-010, August 1988.

(2) United States Environmental Protection Agency, <u>Guideline on Air Quality Models (Revised)</u>, EPA-450/2-78-027, July 1986.

(3) Auer, A.H., <u>Correlation of Land and Cover With Meteorological Anomalies</u>, Journal of Applied Meteorology, 17, 1978, pp. 636-643.

(4) 40 CFR 51, Stack Height Regulations: Final Rule, 1985.

(5) United States Environmental Protection Agency, Office of Solid Waste, <u>Guidance on Metals and Hydrogen Chloride Controls for Hazardous Waste Incinerator (Draft)</u>, March 1989.

(6) American Conference of Governmental and Industrial Hygienists, <u>Threshold Limit Values and Biological Exposure Indices for 1989-1990</u>, 1989.

(7) United States Environmental Protection Agency, <u>Superfund Exposure Assessment Manual, OSWER Directive 9285.5-1</u>, EPA 540/1-88/001, 1988.

(8) United States Environmental Protection Agency, <u>Exposure Factors Handbook</u>, EPA/600/8-89/043, 1989.

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(9)   United States Environmental Protection Agency, <u>Health Effects Assessment Summary Tables</u>, OERR, 9200.6-303-(89-2), 1989.

Zion Chapel No. 2
Cem
BM 140

x133

132

SITE

160

x135

QUADRANGLE LOCATION

BM

110

546.02.20

SITE LOCATION MAP
SCRDI BLUFF ROAD SITE

1   5   0

KM.

<u>LEGEND</u>

▲   PROPOSED LOCATION
    OF INCINERATOR

BLASLAND & BOUCK
ENGINEERS, P.C.

Table 1.   SCRDI – Bluff Road Site ⬤ anic and Metal Emission Rates
and Associated Input Data

Incineration

Soil feed rate (lb/hr)   40,000
Organic destruction efficiency (%)   99.99%

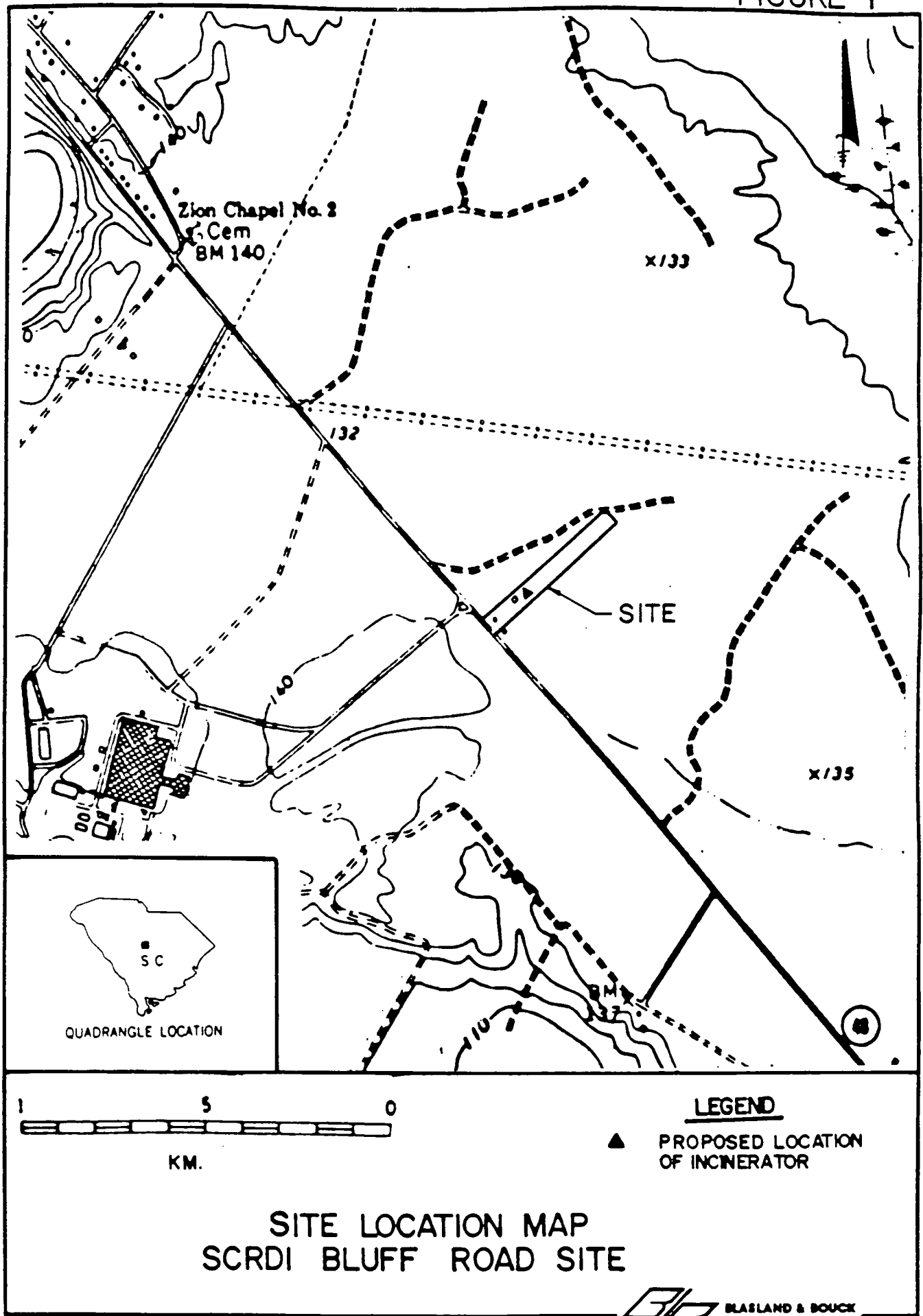| Classification	Chemical Name	Boiling Point (F)	Max Soil Organic Conc. (ppb)	Max Soil Metals Conc. (ppm)	Metals Partitioning Factor (a)	APC (b) Efficiency (c) (%)	Stack Emission Rates Organics (g/sec)	Stack Emission Rates Metals (g/sec)
Volatiles	ACETONE		160000.0				8.06E-05	0.00E+00
	CHLOROFORM		10000.0				5.04E-06	0.00E+00
	1,1,1,-TRICHLOROETHANE		14000.0				7.06E-06	0.00E+00
	METHYLENE CHLORIDE		39000.0				1.97E-05	0.00E+00
	CARBON DISULFIDE		2.0				1.01E-09	0.00E+00
	1,1-DICHLOROETHANE		390.0				1.97E-07	0.00E+00
	2-BUTANONE		89000.0				4.49E-05	0.00E+00
	TRICHLOROETHENE		44000.0				2.22E-05	0.00E+00
	1,1,2,2-TETRACHLOROETHENE		2300000.0				1.16E-03	0.00E+00
	ETHYLBENZENE		18000.0				9.07E-06	0.00E+00
	4-METHYL-2-PENTANONE		340.0				1.71E-07	0.00E+00
	TOLUENE		340000.0				1.71E-04	0.00E+00
	CHLOROBENZENE		23000.0				1.16E-05	0.00E+00
	TETRACHLOROETHENE		95000.0				4.79E-05	0.00E+00
	1,2-DICHLOROETHENE		45.0				2.27E-08	0.00E+00
	XYLENES		62000.0				3.12E-05	0.00E+00
	STYRENE		6.0				3.02E-09	0.00E+00
	VINYL CHLORIDE		24.0				1.21E-08	0.00E+00
	1,1-DICHLOROETHENE		240.0				1.21E-07	0.00E+00
	BENZENE		590.0				2.97E-07	0.00E+00
	1,2-DICHLOROETHANE		120.0				6.05E-08	0.00E+00
	CARBON TETRACHLORIDE		4100.0				2.07E-06	0.00E+00
	1,1,2-TRICHLOROETHANE		7.0				3.53E-09	0.00E+00

Table 1.   SCRDI - Bluff Road Site ●●nic and Metal Emission Rates
and Associated ●●put Data

Incineration

Soil feed rate (lb/hr)   40,000
Organic destruction efficiency (%)   99.99%

Classification	Chemical Name	Boiling Point (F)	Max Soil Organic Conc. (ppb)	Max Soil Metals Conc. (ppm)	Metals Partitioning Factor (a)	APC (b) Efficiency (c) (%)	Stack Emission Rates Organics (g/sec)	Stack Emission Rates Metals (g/sec)
Semi-volatiles	BENZOIC ACID	480.0	110000.0				5.54E-05	0.00E+00
	N-BUTYL PHTHALATE	340.0	2200.0				1.11E-06	0.00E+00
	NAPHTHALENE	410.0	3900.0				1.97E-06	0.00E+00
	2-METHYLPHENOL		120000.0				6.05E-05	0.00E+00
	2-CHLOROPHENOL	347.0	2000000.0				1.01E-03	0.00E+00
	2,4,5-TRICHLOROPHENOL	485.0	810.0				4.08E-07	0.00E+00
	BENZYL ALCOHOL	403.0	330000.0				1.66E-04	0.00E+00
	4-METHYLPHENOL		14000.0				7.06E-06	0.00E+00
	PHENOL	358.0	6300000.0				3.18E-03	0.00E+00
	BIS(2EH)PHTHALATE		7600.0				3.83E-06	0.00E+00
	N-OCTYL PHTHALATE		44000.0				2.22E-05	0.00E+00
	HEXACHLOROBENZENE	612.0	7200.0				3.63E-06	0.00E+00
	ISOPHORONE	419.0	450.0				2.27E-07	0.00E+00
	2,4-DICHLOROPHENOL	410.0	130000.0				6.55E-05	0.00E+00
	DIETHYLPHTHALATE	561.0	1500.0				7.56E-07	0.00E+00
	NITROSODIPHENYLAMINE		820.0				4.13E-07	0.00E+00
	HEXACHLOROETHANE		1200.0				6.05E-07	0.00E+00
	2,4,6-TRICHLOROPHENOL		280.0				1.41E-07	0.00E+00
	NITROBENZENE		11000.0				5.54E-06	0.00E+00

Table 1. SCRDI – Bluff Road Site Organic and Metal Emission Rates
and Associated Input Data

Incineration

Soil feed rate (lb/hr)   40,000

Organic destruction efficiency (%)   99.99%

Classification	Chemical Name	Boiling Point (F)	Max Soil Organic Conc. (ppb)	Max Soil Metals Conc. (ppm)	Metals Partitioning Factor (a)	APC (b) Efficiency (c) (%)	Stack Emission Rates Organics (g/sec)	Stack Emission Rates Metals (g/sec)
Metals	Antimony			6.0	1	90%	0.00E+00	3.02E-03
	Arsenic			8.2	1	90%	0.00E+00	4.13E-03
	Barium			190.0	0.5	95%	0.00E+00	2.39E-02
	Beryllium			1.3	0.05	95%	0.00E+00	1.64E-05
	Cadmium			4.0	1	90%	0.00E+00	2.02E-03
	Chromium			64.0	0.05	95%	0.00E+00	8.06E-04
	Lead			158.0	1	90%	0.00E+00	7.96E-02
	Mercury			6.6	1	50%	0.00E+00	1.66E-02
	Silver			5.0	0.08	95%	0.00E+00	1.01E-04
	Thallium			0.9	1	90%	0.00E+00	4.54E-04

(a) Metals partitioning factor at 1600 F.

(b) Air Pollution Control (APC).

(c) APC metals removal efficiency for fabric filter and wet scrubber, from reference 1.

TABLE 2

DESIGN STACK PARAMETERS FOR
TREATMENT OF SOIL USING INCINERATION

UTM Coordinates (km)		Stack Base Elevation (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Flow Rate (ACFM)	Exhaust Velocity (m/s)	Exhaust Gas Exit Temp. (°K)
Easting	Northing						
508.445	3749.375	41.76	18.29	1.52	60,000	15.52	358.7

TABLE 3

METEOROLOGICAL CONDITIONS USED FOR THE
PTPLU-2 SCREENING ANALYSIS

Stability Class	Wind Speed (m/s)
A	0.5, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0
B	0.5, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0
C	2.0, 2.5, 3.0, 4.0, 5.0, 7.0, 10.0, 12.0, 15.0
D	0.5, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.0, 10.0, 12.0, 15.0, 20.0
E	2.0, 2.5, 3.0, 4.0, 5.0
F	2.0, 2.5, 3.0, 4.0, 5.0

Note: The wind is assumed to be blowing directly from the source to the receptor.

TABLE 4

LOCATIONS OF DISCRETE FENCELINE MODELING RECEPTORS

UTM Coordinates (km)		Elevation	
Easting	Northing	Meters	Feet
508.340	3749.310	42.06	138
508.417	3749.374	42.06	138
508.494	3749.438	41.76	137
508.571	3749.502	41.76	137
508.648	3749.566	41.45	136
508.680	3749.593	41.45	136
508.703	3749.565	41.45	136
508.671	3749.538	41.45	136
508.594	3749.474	41.76	137
508.517	3749.410	41.76	137
508.440	3749.346	42.06	138
508.363	3749.282	42.06	138

TABLE 5

MAXIMUM PREDICTED
1-HOUR AND ANNUAL CONCENTRATIONS
FOR TREATMENT OF SOIL USING INCINERATION

Contaminant	Maximum Concentration (ug/m^3)	
	1-Hour	Annual
Volatiles		
Acetone	9.37×10^{-4}	2.12×10^{-5}
Chloroform	5.86×10^{-5}	1.33×10^{-6}
1,1,1-Trichloroethane	8.20×10^{-5}	1.86×10^{-6}
Methylene Chloride	2.29×10^{-4}	5.18×10^{-6}
Carbon Disulfide	1.17×10^{-8}	2.66×10^{-10}
1,1-Dichloroethane	2.29×10^{-6}	5.18×10^{-8}
2-Butanone	5.22×10^{-4}	1.18×10^{-5}
Trichloroethene	2.58×10^{-4}	5.84×10^{-6}
1,1,2,2-Tetrachloroethane	1.35×10^{-2}	3.05×10^{-4}
Ethylbenzene	1.05×10^{-4}	2.39×10^{-6}
4-Methyl-2-Pentanone	1.99×10^{-6}	4.50×10^{-8}
Toluene	1.99×10^{-3}	4.50×10^{-5}
Chlorobenzene	1.35×10^{-4}	3.05×10^{-6}
Tetrachloroethene	5.57×10^{-4}	1.26×10^{-5}
1,2-Dichloroethene	2.64×10^{-7}	5.97×10^{-9}
Xylenes	3.63×10^{-4}	8.21×10^{-6}
Styrene	3.51×10^{-8}	7.94×10^{-10}
Vinyl Chloride	1.41×10^{-7}	3.18×10^{-9}
1,1-Dichloroethene	1.41×10^{-6}	3.18×10^{-8}
Benzene	3.45×10^{-6}	7.81×10^{-8}
1,2-Dichloroethane	7.03×10^{-7}	1.59×10^{-8}
Carbon Tetrachloride	2.41×10^{-5}	5.44×10^{-7}
1,1,2-Trichloroethane	4.10×10^{-8}	9.28×10^{-10}
Semivolatiles		
Benzoic Acid	6.44×10^{-4}	1.46×10^{-5}
N-Butyl Phthalate	1.29×10^{-5}	2.92×10^{-7}
Naphthalene	2.29×10^{-5}	5.18×10^{-7}
2-Methylphenol	7.03×10^{-4}	1.59×10^{-5}
2-Chlorophenol	1.17×10^{-2}	2.66×10^{-4}
2,4,5-Trichlorophenol	4.74×10^{-6}	1.07×10^{-7}
Benzyl Alcohol	1.93×10^{-3}	4.37×10^{-5}
4-Methylphenol	8.20×10^{-5}	1.86×10^{-6}
Phenol	3.70×10^{-2}	8.36×10^{-4}
Bis(2eh)Phthalate	4.45×10^{-5}	1.01×10^{-6}
N-Octyl Phthalate	2.58×10^{-4}	5.84×10^{-6}
Hexachlorobenzene	4.22×10^{-5}	9.55×10^{-7}
Isophorone	2.64×10^{-6}	5.97×10^{-8}
2,4-Dichlorophenol	7.61×10^{-4}	1.72×10^{-5}

TABLE 5 (Cont'd.)

MAXIMUM PREDICTED
1-HOUR AND ANNUAL CONCENTRATIONS
FOR TREATMENT OF SOIL USING INCINERATION

Contaminant	Maximum Concentration (ug/m^3)	
	1-Hour	Annual
Semivolatiles (Cont'd.)		
Diethylphthalate	8.79×10^{-6}	1.99×10^{-7}
Nitrosodiphenylamine	4.80×10^{-6}	1.09×10^{-7}
Hexachloroethane	7.03×10^{-6}	1.59×10^{-7}
2,4,6-Trichlorophenol	1.64×10^{-6}	3.80×10^{-8}
Nitrobenzene	6.44×10^{-5}	3.71×10^{-6}
Metals		
Antimony	3.51×10^{-2}	7.94×10^{-4}
Arsenic	4.80×10^{-2}	1.09×10^{-3}
Barium	2.78×10^{-1}	6.29×10^{-3}
Beryllium	1.91×10^{-4}	4.31×10^{-6}
Cadmium	2.35×10^{-2}	5.31×10^{-4}
Chromium	9.37×10^{-3}	2.12×10^{-4}
Lead	9.25×10^{-1}	2.09×10^{-2}
Mercury	1.93×10^{-1}	4.37×10^{-3}
Silver	1.17×10^{-3}	2.66×10^{-5}
Thallium	5.28×10^{-3}	1.19×10^{-4}

TABLE 6

THRESHOLD LIMIT VALUES
FOR INCINERATOR EMISSIONS

Contaminant	Maximum[1] 1-Hour Concentration (ug/m^3)	Threshold[2] Limit Values Time Weighted Averages (ug/m^3)
Volatiles		
Acetone	9.37×10^{-4}	1.78×10^{6}
Chloroform	5.86×10^{-5}	4.90×10^{4}
1,1,1-Trichloroethane	8.20×10^{-5}	1.91×10^{6}
Methylene Chloride	2.29×10^{-4}	1.74×10^{5}
Carbon Disulfide	1.17×10^{-8}	3.10×10^{4}
1,1-Dichloroethane	2.29×10^{-6}	8.10×10^{5}
2-Butanone	5.22×10^{-4}	5.90×10^{5}
Trichloroethene	2.58×10^{-4}	2.69×10^{5}
1,1,2,2-Tetrachloroethane	1.35×10^{-2}	6.90×10^{3}
Ethylbenzene	1.05×10^{-4}	4.34×10^{5}
4-Methyl-2-Pentanone	1.99×10^{-6}	
Toluene	1.99×10^{-3}	3.77×10^{5}
Chlorobenzene	1.35×10^{-4}	4.60×10^{4}
Tetrachloroethene	5.57×10^{-4}	3.39×10^{5}
1,2-Dichloroethene	2.64×10^{-7}	3.47×10^{5}
Xylenes	3.63×10^{-4}	4.34×10^{5}
Styrene	3.51×10^{-8}	2.13×10^{5}
Vinyl Chloride	1.41×10^{-7}	1.30×10^{4}
1,1-Dichloroethene	1.41×10^{-6}	2.00×10^{4}
Benzene	3.45×10^{-6}	3.20×10^{4}
1,2-Dichloroethane	7.03×10^{-7}	4.00×10^{4}
Carbon Tetrachloride	2.41×10^{-5}	3.10×10^{4}
1,1,2-Trichloroethane	4.10×10^{-8}	5.50×10^{4}
Semivolatile Compounds		
Benzoic Acid	6.44×10^{-4}	1.90×10^{4}
N-Butyl Phthalate	1.29×10^{-5}	
Naphthalene	2.29×10^{-5}	5.20×10^{4}
2-Methylphenol	7.03×10^{-4}	2.20×10^{4}
2-Chlorophenol	1.17×10^{-2}	
2,4,5-Trichlorophenol	4.74×10^{-6}	
Benzyl Alcohol	1.93×10^{-3}	
4-Methylphenol	8.20×10^{-5}	2.20×10^{4}
Phenol	3.70×10^{-2}	1.90×10^{4}

TABLE 6 (Cont'd.)

THRESHOLD LIMIT VALUES
FOR INCINERATOR EMISSIONS

Contaminant	Maximum[1] 1-Hour Concentration (ug/m^3)	Threshold[2] Limit Values Time Weighted Averages (ug/m^3)
Semivolatile Compounds (Cont'd.)		
Bis(2eh)phthalate	4.45×10^{-5}	5.00×10^{3}
N-Octylphthalate	2.58×10^{-4}	
Hexachlorobenzene	4.22×10^{-5}	
Isophorone	2.64×10^{-6}	2.80×10^{4}
2,4-Dichlorophenol	7.61×10^{-4}	
Diethylphthalate	8.79×10^{-6}	5.00×10^{3}
Nitrosodiphenylamine	4.80×10^{-6}	
Hexachloroethane	7.03×10^{-6}	9.70×10^{3}
2,4,6-Trichlorophenol	1.64×10^{-6}	
Nitrobenzene	6.44×10^{-5}	5.00×10^{3}
Metals		
Antimony	3.51×10^{-2}	5.00×10^{2}
Arsenic	4.80×10^{-2}	2.00×10^{2}
Barium	2.78×10^{-1}	5.00×10^{2}
Beryllium	1.91×10^{-4}	2.00
Cadmium	2.35×10^{-2}	1.00×10^{1}
Chromium	9.37×10^{-3}	5.00×10^{2}
Lead	9.25×10^{-1}	1.50×10^{2}
Mercury	1.93×10^{-1}	1.00×10^{1}
Silver	1.17×10^{-3}	1.00×10^{2}
Thallium	5.28×10^{-3}	1.00×10^{2}

Notes:

[1]   Values derived from air modeling described previously.

[2]   TLV-TWA represents an exposure for an 8-hour day/40-hour work week, which results in no adverse effects. [6]

TABLE   7

EXPOSURE SCENARIO FOR WORKER
INHALATION OF AIRBORNE CONTAMINANTS FROM
INCINERATOR EMISSIONS

Receptors: On-site workers
Adult or Child: Adult
Male/Female: Male
Activity Level: Moderate
Frequency of Event: 200 days/year
Duration of Event: 8 hours/day
Inhalation Rate: 2.8 m^3/hour [7]
Weight: 70 kg [8]

Potential Exposure Pathways Considered Significant:

<u>Inhalation of Ambient Air</u>

Compounds: All site-specific chemicals.

Data Sets: Maximum annual concentrations
                              predicted from modeling incinerator
                              emissions.

TABLE 8

EXPOSURE SCENARIO FOR 6-YEAR OLD CHILD AT OFF-SITE AREA
INHALATION OF AIRBORNE CONTAMINANTS FROM
INCINERATOR EMISSIONS

Receptors:	6-year old child
Adult or Child:	Child
Male/Female:	Male
Activity Level:	Moderate activity
Frequency of Event:	200 days/year
Duration of Event:	4 hours/day
Inhalation Rate:	2.1 m^3/hour [7]
Weight:	19.7 kg [8]

Potential Exposure Pathways Considered Significant:

Inhalation of Ambient Air

Compounds:	All site-specific chemicals.
Data Sets:	Maximum annual concentrations predicted from modeling incinerator emissions.

TABLE 9

RISK CALCULATIONS FOR WORKERS
INHALATION OF AIRBORNE CONTAMINANTS
FROM INCINERATOR EMISSIONS

Chemical	Maximum Annual Air Concent. (ug/m^3)	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF (mg/kg/day)$^{-1}$	Inhalation AIC/RfD (mg/kg/day)	Risk	Hazard Index
Volatiles						
Acetone	2.12×10^{-5}	5.3×10^{-11}				
Chloroform	1.33×10^{-6}	3.3×10^{-12}	8.1×10^{-2}		2.7×10^{-13}	
1,1,1-Trichloroethane	1.86×10^{-6}	4.6×10^{-12}		3.0×10^{-1}		1.5×10^{-11}
Methylene Chloride	5.18×10^{-6}	1.3×10^{-11}	1.4×10^{-2}		1.8×10^{-13}	
Carbon Disulfide	2.66×10^{-10}	6.6×10^{-16}				
1,1-Dichloroethane	5.18×10^{-8}	1.3×10^{-13}		1.0×10^{-1}		1.3×10^{-12}
2-Butanone	1.18×10^{-5}	3.0×10^{-11}				
Trichloroethene	5.84×10^{-6}	1.5×10^{-11}	1.3×10^{-2}		1.9×10^{-13}	
1,1,2,2-Tetrachloroethane	3.05×10^{-4}	7.6×10^{-10}	2.0×10^{-1}		1.5×10^{-10}	
Ethylbenzene	2.39×10^{-6}	6.0×10^{-12}				
4-Methyl-2-Pentanone	4.50×10^{-8}	1.1×10^{-13}				
Toluene	4.50×10^{-5}	1.1×10^{-10}		1.0		1.1×10^{-10}
Chlorobenzene	3.05×10^{-6}	7.6×10^{-12}		5.0×10^{-3}		1.5×10^{-9}
Tetrachloroethene	1.26×10^{-5}	3.2×10^{-11}	3.3×10^{-3}		1.0×10^{-13}	
1,2-Dichloroethene	5.97×10^{-9}	1.5×10^{-14}				
Xylenes	8.21×10^{-6}	2.1×10^{-11}		4.0×10^{-1}		5.1×10^{-11}
Styrene	7.94×10^{-10}	2.0×10^{-15}		1.0×10^{-2}		2.0×10^{-13}
Vinyl Chloride	3.18×10^{-9}	8.0×10^{-15}	2.9×10^{-1}		2.3×10^{-15}	
1,1-Dichloroethene	3.18×10^{-8}	8.0×10^{-14}	1.2		9.5×10^{-14}	
Benzene	7.81×10^{-8}	2.0×10^{-13}	2.9×10^{-2}		5.7×10^{-15}	
1,2-Dichloroethane	1.59×10^{-8}	4.0×10^{-14}	9.1×10^{-2}		3.6×10^{-15}	
Carbon Tetrachloride	5.44×10^{-7}	1.4×10^{-12}	1.3×10^{-1}		1.8×10^{-13}	
1,1,2-Trichloroethane	9.28×10^{-10}	2.3×10^{-15}	5.7×10^{-2}		1.3×10^{-16}	

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TABLE 9 (Cont'd.)

RISK CALCULATIONS FOR WORKERS
INHALATION OF AIRBORNE CONTAMINANTS
FROM INCINERATOR EMISSIONS

Chemical	Maximum Annual Air Concent. (ug/m^3)	Inhalation Exposure Dosage $(mg/kg/day)$	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RfD $(mg/kg/day)$	Risk	Hazard Index
Semivolatiles:						
Benzoic Acid	1.46×10^{-5}	3.6×10^{-11}				
N-Butyl Phthalate	2.92×10^{-7}	7.3×10^{-13}				
Naphthalene	5.18×10^{-7}	1.3×10^{-12}				
2-Methylphenol	1.59×10^{-5}	4.0×10^{-11}				
2-Chlorophenol	2.66×10^{-4}	6.6×10^{-10}				
2,4,5-Trichlorophenol	1.07×10^{-7}	2.7×10^{-13}				
Benzyl Alcohol	4.37×10^{-5}	1.1×10^{-10}				
4-Methylphenol	1.86×10^{-6}	4.6×10^{-12}				
Phenol	8.36×10^{-4}	2.1×10^{-9}				
Bis(2eh)phthalate	1.01×10^{-6}	2.5×10^{-12}				
N-Octyl phthalate	5.84×10^{-6}	1.5×10^{-11}				
Hexachlorobenzene	9.55×10^{-7}	2.4×10^{-12}	1.7		4.1×10^{-12}	
Isophorone	5.97×10^{-8}	1.5×10^{-13}				
2,4-Dichlorophenol	1.72×10^{-5}	4.3×10^{-11}				
Diethylphthalate	1.99×10^{-7}	5.0×10^{-13}				
Nitrosodiphenylamine	1.09×10^{-7}	2.7×10^{-13}				
Hexachloroethane	1.59×10^{-7}	4.0×10^{-13}				
2,4,6-Trichlorophenol	3.80×10^{-8}	9.3×10^{-14}	2.0×10^{-2}		1.9×10^{-15}	
Nitrobenzene	3.71×10^{-6}	3.6×10^{-12}		6.0×10^{-4}		6.1×10^{-9}
Metals						
Antimony	7.94×10^{-4}	2.0×10^{-9}				
Arsenic	1.09×10^{-3}	2.7×10^{-9}	5.0×10^{1}		1.4×10^{-7}	

TABLE 9 (Cont'd.)

RISK CALCULATIONS FOR WORKERS
INHALATION OF AIRBORNE CONTAMINANTS
FROM INCINERATOR EMISSIONS

Chemical	Maximum Annual Air Concent. (ug/m^3)	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RfD (mg/kg/day)	Risk	Hazard Index
Metals (Cont'd.)						
Barium	6.29×10^{-3}	1.6×10^{-8}		1.0×10^{-4}		1.6×10^{-4}
Beryllium	4.31×10^{-6}	1.1×10^{-11}	8.4		9.1×10^{-11}	
Cadmium	5.31×10^{-4}	1.3×10^{-9}	6.1		8.1×10^{-9}	
Chromium VI	2.12×10^{-4}	5.3×10^{-10}	4.1×10^{1}		2.2×10^{-8}	
Chromium III	2.12×10^{-4}	5.3×10^{-10}		5.1×10^{-3}		1.0×10^{-7}
Lead (inorganic)	2.09×10^{-2}	5.2×10^{-8}		4.3×10^{-4}		1.2×10^{-4}
Mercury (inorganic)	4.37×10^{-3}	1.1×10^{-8}		5.1×10^{-5}		2.1×10^{-4}
Silver	2.66×10^{-5}	6.6×10^{-11}				
Thallium	1.19×10^{-4}	3.0×10^{-10}				
				TOTAL	1.7×10^{-7}	4.9×10^{-4}

TABLE 10

RISK CALCULATIONS FOR 6-YEAR OLD CHILD
INHALATION OF AIRBORNE CONTAMINANTS
FROM INCINERATOR EMISSIONS

Chemical	Maximum Annual Air Concent. (ug/m^3)	Inhalation Exposure Dosage $(mg/kg/day)$	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RID $(mg/kg/day)$	Risk	Hazard Index
Volatiles						
Acetone	2.12×10^{-5}	7.1×10^{-11}				
Chloroform	1.33×10^{-6}	4.4×10^{-12}	8.1×10^{-2}		3.6×10^{-13}	
1,1,1-Trichloroethane	1.86×10^{-6}	6.2×10^{-12}		3.0×10^{-1}		2.1×10^{-11}
Methylene Chloride	5.18×10^{-6}	1.7×10^{-11}	1.4×10^{-2}		2.5×10^{-13}	
Carbon Disulfide	2.66×10^{-10}	8.8×10^{-16}				
1,1-Dichloroethane	5.18×10^{-8}	1.7×10^{-13}		1.0×10^{-1}		1.7×10^{-12}
2-Butanone	1.18×10^{-5}	3.9×10^{-11}				
Trichloroethene	5.84×10^{-6}	1.9×10^{-11}	1.3×10^{-2}		2.5×10^{-13}	
1,1,2,2-Tetrachloroethane	3.05×10^{-4}	1.0×10^{-9}	2.0×10^{-1}		2.0×10^{-10}	
Ethylbenzene	2.39×10^{-6}	7.9×10^{-12}				
4-Methyl-2-Pentanone	4.50×10^{-8}	1.5×10^{-13}				
Toluene	4.50×10^{-5}	1.5×10^{-10}		1.0		1.5×10^{-10}
Chlorobenzene	3.05×10^{-6}	1.0×10^{-11}		5.0×10^{-3}		2.0×10^{-9}
Tetrachloroethene	1.26×10^{-5}	4.2×10^{-11}	3.3×10^{-3}		1.4×10^{-13}	
1,2-Dichloroethene	5.97×10^{-9}	2.0×10^{-14}				
Xylenes	8.21×10^{-6}	2.7×10^{-11}		4.0×10^{-1}		6.8×10^{-11}
Styrene	7.94×10^{-10}	2.6×10^{-15}		1.0×10^{-2}		2.6×10^{-13}
Vinyl Chloride	3.18×10^{-9}	1.1×10^{-14}	2.9×10^{-1}		3.1×10^{-15}	
1,1-Dichloroethene	3.18×10^{-8}	1.1×10^{-13}	1.2		1.3×10^{-13}	
Benzene	7.81×10^{-8}	2.6×10^{-13}	2.9×10^{-2}		7.5×10^{-15}	
1,2-Dichloroethane	1.59×10^{-8}	5.3×10^{-14}	9.1×10^{-2}		4.8×10^{-15}	
Carbon Tetrachloride	5.44×10^{-7}	1.8×10^{-12}	1.3×10^{-1}		2.4×10^{-13}	
1,1,2-Trichloroethane	9.28×10^{-10}	3.1×10^{-15}	5.7×10^{-2}		1.8×10^{-16}	

RISK CALCULATIONS FOR 6-YEAR OLD CHILD
INHALATION OF AIRBORNE CONTAMINANTS
FROM INCINERATOR EMISSIONS

Chemical	Maximum Annual Air Concent. (ug/m^3)	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RfD (mg/kg/day)	Risk	Hazard Index
Semivolatiles						
Benzoic Acid	1.46×10^{-5}	4.9×10^{-11}				
N-Butyl Phthalate	2.92×10^{-7}	9.7×10^{-13}				
Naphthalene	5.18×10^{-7}	1.7×10^{-12}				
2-Methylphenol	1.59×10^{-5}	5.3×10^{-11}				
2-Chlorophenol	2.66×10^{-4}	8.8×10^{-10}				
2,4,5-Trichlorophenol	1.07×10^{-7}	3.6×10^{-13}				
Benzyl Alcohol	4.37×10^{-5}	1.5×10^{-10}				
4-Methylphenol	1.86×10^{-6}	6.2×10^{-12}				
Phenol	8.36×10^{-4}	2.8×10^{-9}				
Bis(2eh)phthalate	1.01×10^{-6}	3.4×10^{-12}				
N-Octylphthalate	5.84×10^{-6}	1.9×10^{-11}				
Hexachlorobenzene	9.55×10^{-7}	3.2×10^{-12}	1.7		5.4×10^{-12}	
Isophorone	5.97×10^{-8}	2.0×10^{-13}				
2,4-Dichlorophenol	1.72×10^{-5}	5.7×10^{-11}				
Diethylphthalate	1.99×10^{-7}	6.6×10^{-13}				
Nitrosodiphenylamine	1.09×10^{-7}	3.6×10^{-13}				
Hexachloroethane	1.59×10^{-7}	5.3×10^{-13}				
2,4,6-Trichlorophenol	3.80×10^{-8}	1.2×10^{-13}	2.0×10^{-2}		2.5×10^{-15}	
Nitrobenzene	3.71×10^{-6}	4.9×10^{-12}		6.0×10^{-4}		8.1×10^{-9}
Metals						
Antimony	7.94×10^{-4}	2.6×10^{-9}				
Arsenic	1.09×10^{-3}	3.6×10^{-9}	5.0×10^{1}		1.8×10^{-7}	
Barium	6.29×10^{-3}	2.1×10^{-8}		1.0×10^{-4}		2.1×10^{-4}
Beryllium	4.31×10^{-6}	1.4×10^{-11}	8.4		1.2×10^{-10}	
Cadmium	5.31×10^{-4}	1.8×10^{-9}	6.1		1.1×10^{-8}	

RISK CALCULATIONS FOR 6-YEAR OLD CHILD
INHALATION OF AIRBORNE CONTAMINANTS
FROM INCINERATOR EMISSIONS

Chemical	Maximum Annual Air Concent. (ug/m^3)	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RID (mg/kg/day)	Risk	Hazard Index
Metals (Cont'd.)						
Chromium VI	2.12×10^{-4}	7.0×10^{-10}	4.1×10^{-1}		2.9×10^{-8}	
Chromium III	2.12×10^{-4}	7.1×10^{-10}		5.1×10^{-3}		1.4×10^{-7}
Lead (inorg)	2.09×10^{-2}	7.0×10^{-8}		4.3×10^{-4}		1.6×10^{-4}
Mercury (inorg)	4.37×10^{-3}	1.3×10^{-8}		5.1×10^{-5}		2.9×10^{-4}
Silver	2.66×10^{-5}	8.8×10^{-11}				
Thallium	1.19×10^{-4}	4.0×10^{-10}				
				TOTAL	2.2×10^{-7}	6.6×10^{-4}

APPENDIX G

AIR QUALITY IMPACT ANALYSIS AND PUBLIC HEALTH EVALUATION FOR
TREATMENT OF SOIL USING THERMAL DESORPTION AT
THE SCRDI BLUFF ROAD SITE

AIR QUALITY IMPACT ANALYSIS AND PUBLIC HEALTH EVALUATION FOR TREATMENT OF SOIL USING THERMAL DESORPTION AT THE SCRDI BLUFF ROAD SITE

An evaluation to assess the health effects associated with air emissions from the on-site treatment of soil using thermal desorption at the SCRDI Bluff Road site is presented in this document. Air quality dispersion modeling was performed to predict maximum ambient air impacts to support this evaluation. Long-term modeling was conducted to determine maximum annual impacts using 5 years of regional National Weather Service (NWS) meteorological data. Short-term impacts were evaluated using a screening model to estimate the maximum 1-hour concentrations based on a worst-case combination of atmospheric stability and wind speed.

Section 1 discusses the dispersion modeling techniques employed. Section 2 presents the input data used. Section 3 describes the procedure for modeling receptor selection. Section 4 presents the dispersion modeling results. Section 5 presents the public health evaluation.

1. Dispersion Modeling Techniques

Both screening and refined modeling were conducted as part of the air quality dispersion analysis. For short-term impacts (24 hours or less), the United States Environmental Protection Agency (USEPA) recommends use of a screening model to estimate conservative short-term impacts for pollutants released from a stationary source.[1] If, based on appropriate screening techniques, the concentration of a pollutant is predicted below an acceptable health-based level, no further modeling of the pollutant is required due to the

conservative nature of the prediction. If, on the other hand, the predicted concentration is above this acceptable health-based level, a refined modeling analysis is necessary to predict the short-term maximum concentration.

USEPA recommendations contained in Guideline on Air Quality Models (Revised)[2] were used to select the appropriate dispersion models. Three factors were considered:

a. Whether the area is classified as urban or non-urban according to USEPA modeling protocols;

b. Whether it is necessary to consider plume impact upon complex terrain; and

c. Whether it is necessary to consider building-induced aerodynamic downwash effects.

Figure 1 presents a site location map depicting the site boundary and surrounding area. The area surrounding the site is non-urban based on recommended USEPA classification procedures. The recommended method is to apply the Auer Classification Scheme[3] to classify land use patterns within 3 km of a site. United States Geological Survey (USGS) topographic maps for the site and vicinity clearly indicate that the area is non-urban; therefore modeling was conducted in the non-urban or rural mode.

The proposed stack height and results of the screening modeling are used to determine whether plume impact upon complex terrain need by considered. Preliminary screening modeling results based on a proposed stack height of 60 feet indicated that maximum impacts (discussed further in Section 4) would occur well within 4.7 kilometers of the source. The area surrounding the site (within 4.7 km) has terrain elevations ranging from 60 feet above to 27 feet below stack base elevation. However, the elevations approaching stack height occur in an isolated area beyond 4.5 km north-northeast of the site, with all other areas having elevations less than 50 feet above stack base. In accordance with USEPA guidance,[2] it is not necessary to consider plume impact upon terrain; therefore, a simple terrain model was used.

Finally, as designed, the incinerator will achieve a Good Engineering Practice (GEP) stack height based on nearby and/or adjacent building geometry.[4] As such, it was not necessary to model aerodynamic building-induced downwash effects.

Based on the above considerations, the Industrial Source Complex Long-Term (ISCLT) model was used to predict annual concentrations, and the Point-Plume-2 (PTPLU-2) model was used to predict maximum 1-hour concentrations. Results using the PTPLU-2 model were also employed to select receptors for use in modeling with ISCLT model. Options used in ISCLT and PTPLU-2 are consistent with USEPA guidance.[2] For both models, the options selected included the adjustment of the stack height for stack tip downwash, determination of final plume rise for all downwind receptor locations, determination of plume enhancement due to buoyancy effects, and use of

rural-mode wind profile coefficients.

2.   Input Data Used

The dispersion modeling analysis to evaluate air quality impacts from on-site thermal desorption required development and input of a detailed emissions inventory, and assembly and input of representative meteorological data.   Each of these two areas is discussed below.

2.1   Emissions Inventory

Table 1 presents stack emission rates and associated input data.   Table 2 presents design stack parameters.   Data presented in these two tables are based on the processing of 40 tons of soil per hour.

Based on vendor input, the stack flow for a thermal desorption unit treating 40 tons per hour (TPH) of low-BTU soil would be about 28,000 ACFM at 160°F.   The vendor system includes a fabric filter for particulate control, a wet scrubber for acid gas removal, and a carbon bed for organic removal.   In order to estimate the stack concentrations, the maximum soil concentration of each organic was assumed to be the average value.   These values are shown in Table 1 for volatiles, semivolatiles, and metals.   It was assumed that 100 percent of the organics would be vaporized from the soil, that 99.99 percent of each organic would be absorbed in the carbon beds, and that none of the remaining 0.01 percent of each organic would be removed in the fabric

filter or the wet scrubber. As an example, the calculations for the acetone stack flow rate (SFR), based on these assumptions, would be as follows:

$$SFR \ (g/s) = \frac{40 \ tons}{hr} \times \frac{2,000 \ lb}{ton} \times \frac{160,000}{10^9} \times 0.0001 \times \frac{453.6 \ g/lb}{3,600 \ s/hr}$$

$$= 1.61 \times 10^{-4} \ g/s$$

The following ten metals were used in determining the stack emissions and were taken from Volume IV of the Hazardous Waste Incineration Guidance Series.[5]

Antimony	Chromium
Arsenic	Lead
Barium	Mercury
Beryllium	Silver
Cadmium	Thallium

In order to estimate the stack concentration, the maximum soil concentration of each metal was assumed to be the average value. These values are also shown in Table 1. The partitioning factor for each metal was estimated at a soil temperature of 600°F using vapor pressure data and engineering judgement. The Air Pollution Control (APC) removal efficiency values given in this table were taken from the metals guidance document. A partitioning factor of 1.0 indicates that the particular metal will vaporize completely in the thermal desorption unit at 600°F. A partitioning factor of 0.05 means that 5 percent of the

particular metal will vaporize and/or be entrained in the thermal desorption unit at 600°F. An APC removal efficiency of 90 percent means that 90 percent of the particular metal will be removed in the APC system which is a fabric filter and a wet scrubber.

As an example, the calculations for the antimony stack flow rate would be as follows:

$$\text{SFR (g/s)} = \frac{40 \text{ ton}}{\text{hr}} \times \frac{2000 \text{ lb}}{\text{ton}} \times \frac{6}{10^6} \times 0.05 \times (1\text{-}0.9) \times \frac{453.6 \text{ g/lb}}{3600 \text{ s/hr}}$$

$$= 3.02 \times 10^{-4} \text{ g/s}$$

2.2 Meteorological Data

Representative meteorology was used in the screening modeling using PTPLU-2 and refined modeling using ISCLT.

Table 3 presents the meteorological conditions used for the PTPLU-2 screening analysis. PTPLU-2 predicts the maximum downwind concentrations based on discrete combinations of stability class and wind speed, and does not require actual meteorology representative of the source location.

The ISCLT model employed 5 years of annual stability array (STAR) data based on hourly observations from the NWS station in Columbia, South Carolina. The data provides annual joint frequencies of stability versus

wind speed and wind direction. The period of record employed was the years 1982 through 1986. Annual modeling was conducted separately for each of the 5 years of meteorological data.

3. Modeling Receptor Selection

Receptors were identified to ensure selection of downwind locations at which the highest concentrations would occur for both 1-hour concentrations predicted using PTPLU-2 and annual concentrations predicted using ISCLT.

3.1 PTPLU-2 Receptors

Because PTPLU-2 does not use actual meteorology, locations of the highest predicted concentrations are determined as relative distances from the source based on discrete wind speed and stability combinations (refer to Table 3). Predictions are first made at fixed distances downwind of the source. Then, from the location at which the highest downwind concentration is predicted, the distance to the maximum concentration is incrementally searched for and located to the nearest 1 meter.

3.2 ISCLT Receptors

The ISCLT receptor grid consisted of a polar coordinate grid and additional receptors located on the site property/fenceline. A total of 444 receptors were used in ISCLT modeling.

The polar coordinate receptor grid was based on the PTPLU-2 screening results.   The PTPLU-2 analysis using the input stack parameters presented in Table 2 identified distances to potential high-impact receptors as a function of the stability class/wind speed combinations presented in Table 3.   Receptor ring distances of 0.22, 0.27, 0.35, 0.46, 0.55, 0.65, 0.73, 0.87, 1.0, 2.0, 3.0, and 4.7 km were selected.

Each of the above 12 polar coordinate rings was divided into 10-degree sectors, yielding a total of 36 receptors per ring.   Variation in terrain within the vicinity of each receptor was accounted for by using the highest terrain elevation in a nearly rectangular area surrounding that receptor.   The area was bounded on either side by an arc length which was plus or minus 5 degrees of the actual receptor location.   The top and bottom of the rectangular area was bounded by half the distance to the preceding and following polar receptor rings.

Table 4 identifies 12 additional discrete fenceline modeling receptor locations surrounding the proposed thermal desorption unit.   These additional receptors were selected to provide an added measure of confidence that the area of greatest impact would be identified.

4.   Dispersion Modeling Results

Table 5 presents the maximum predicted 1-hour and annual concentrations for each contaminant listed in Table 1.   The distance to the receptor predicted to have the maximum 1-hour concentration, based on PTPLU-2

modeling, is 394m from the source. The location at which the maximum annual predicted concentration occurs, based on ISCLT modeling, is located 200° (south-southwest) from the source at a distance of 550m.

5.   Public Health Evaluation

Based on the modeling results, a public health evaluation (PHE) may be performed for the receptor groups which are likely to experience maximum exposures to airborne emissions from the thermal desorption unit. The modeling results identified the downwind distance where maximum 1-hour concentrations would be expected, and the location where maximum annual concentrations would be expected. This PHE identifies the likely receptors associated with those locations, formulates worst-case exposure scenarios for the most-exposed receptors, and quantitatively estimates exposure levels and associated health risks for those exposure pathways.

5.1 Receptors

Based on the location where maximum short- and long-term air contaminant concentrations are predicted to occur, it is possible to identify two receptor groups which may experience maximum exposures to airborne contaminants. These groups are: (1) remediation workers in the immediate vicinity of the emissions source (i.e., the thermal desorption unit) who would be the closest receptors and who might be exposed to short-term peak concentrations; and (2) off-site residents who might be exposed to lower concentrations for longer periods. To

represent the first group, it is assumed that the most-exposed individual (MEI) would be an adult worker. The MEI for the second group is identified as a 6-year old child. The child is used because of his higher inhalation rate to body weight ratio, thus resulting in a maximum (worst-case) exposure dosage estimate. Selection of a child of this age is also related to the possibility that he might play in the area of the site, even though there are no residences in the immediate vicinity. (The nearest residence is over 1 mile away.) It was felt that younger children would not be likely to travel the distances necessary to get near the site. The use of the 6-year old child therefore provides a worst-case estimate of exposure.

5.2 Exposure Assessment

Table 6 presents Threshold Limit Values (TLVs) for each contaminant of concern, and compares the values to maximum predicted 1-hour concentrations. TLVs were developed by the American Conference of Governmental and Industrial Hygienists (ACGIH), [6] and are occupational exposure criteria that represent airborne concentrations of substances to which nearly all workers may be repeatedly exposed without adverse effects. TLVs presented in Table 6 represent time-weighted average (TWA) concentrations to which individuals may be exposed during a normal 8-hour workday and 40-hour workweek without experiencing any adverse health effects. TLVs are based on the best available information from industrial experience, as well as data from human and animal studies. TLVs are used in industrial hygiene practice to control potential

health hazards for workers. TLVs are issued by the ACGIH, and are guidelines rather than enforceable standards.

Because the maximum predicted 1-hour concentrations are far below TLVs for long-term occupational exposure, it is concluded that there is no danger of acute toxicity due to exposure to short-term peak emissions from the thermal desorption unit. The remainder of the PHE will, therefore, address only the potential for long-term health effects.

Table 7 presents assumptions used in the worker exposure scenario. As discussed previously, it is assumed that this worker is an adult male involved in work at the site. The period of exposure is estimated to be 100 days, i.e., the time during which the thermal desorption unit is expected to be operating. An inhalation rate of 2.8 m^3/hour, corresponding to an adult male involved in moderate activity, [7] is used.

The assumptions listed in Table 7 are incorporated to calculate exposure dosages using the following equation:

$$IEX = AC \times IR \times D \times (1/1,000) \div BW \times EP \div 25,600$$

Where:

IEX	=	inhalation exposure dosage (mg/kg/day)
AC	=	airborne contaminant concentration (ug/m^3)
IR	=	inhalation rate (m^3/hour)

D	=	duration of daily exposure (hours/day)
1/1,000	=	conversion factor (mg/ug)
BW	=	body weight (kg)
EP	=	exposure period (days)
25,600	=	length of human lifetime (days)

Maximum annual average contaminant concentrations from Table 5 are used in this calculation as AC values to provide worst-case estimates of long-term exposure levels.

Table 8 presents assumptions used in the exposure scenario involving the 6-year old child. These assumptions are the same as used in the first scenario with the following exceptions. Because the receptor is a child, a different body weight (19.7 kg) and inhalation rate (2.1 m^3/hour) are used. [7], [8] In addition, the duration of an exposure period is assumed to be 4 hours/day rather than 8 hours/day. This value represents a reasonable worst-case average for this parameter because it is not likely that children will be playing near the site for extended periods due to the fact that the nearest residence is more than 1 mile away.

The same equation used previously is again used to calculate exposure estimates. Once again, maximum annual average contaminant concentrations from Table 5 are used in this calculation as AC values to provide worst-case estimates of long-term exposure levels. -

5.3 Toxicity Assessment

Table 9 and 10 present human health criteria for inhalation exposure to the contaminants of interest. These values were obtained from USEPA Health Effects Assessment Summary Tables.[9] For those contaminants that are considered potential carcinogens, a Cancer Potency Factor (CPF) is presented. The CPF is expressed in units of inverse dosage, i.e., $(mg/kg/day)^{-1}$. Simply stated, it represents the increase in risk of cancer mortality per unit of exposure dosage. In most cases, CPFs are derived using data from animal experiments and by applying a low-dose extrapolation model that incorporates conservative assumptions concerning interspecies extrapolation.

For compounds not regarded as potential carcinogens, a Reference Dose (RfD), also called an Acceptable Intake for Chronic Exposure (AIC), is provided. This value represents the exposure dosage in mg/kg/day which, if consumed daily throughout a person's lifetime, would not result in any adverse health effects. USEPA usually derives RfDs based on animal data which define a no-effect dosage or threshold for toxicity. This threshold value is divided by a conservative safety factor, typically 100 or 1,000, to derive a human RfD. These RfD values may then be used to determine a Hazard Index (HI) for given exposures. The HI is the ratio of the estimated exposure level to the RfD value. HI values greater than 1.0 may indicate a potential health risk.

For chromium, toxicity values for both hexavalent and trivalent chromium are presented. Because emission estimates are expressed as total chromium, cancer risks will be estimated assuming that all of the chromium present is hexavalent, the more toxic form.

As shown in Tables 9 and 10, not all of the compounds of interest have toxicity criteria available. As a result, they cannot be evaluated quantitatively and are not included in subsequent risk estimates. This should be considered as an area of uncertainty in the PHE.

The approach used to characterize risk in this section is analogous to the methods used in the original baseline RI risk assessment conducted by IT Corporation.

5.4   Risk Characterization

This section describes the potential risks associated with estimated exposure levels calculated as described previously.

For the adult worker exposure scenario, estimated incremental lifetime cancer risks and hazard indices are presented in Table 9. As shown in this table, the total estimated cancer risk associated with exposure to maximum concentrations of all of the chemicals of interest is 4.3×10^{-7} under the conditions of this scenario. The compound which contributes the major portion of this total risk is arsenic (3.5×10^{-7}). The total HI for non-carcinogenic effects is 9.1×10^{-4}, which is far

below the 1.0 value which indicates a potential hazard.

For the childhood exposure scenario, estimated incremental cancer risks and hazard indices are presented in Table 10. As shown in this table, the total estimated cancer risk associated with exposure to maximum concentrations of all contaminants of interest is 5.7×10^{-7}. The principal contributor to this total risk level is arsenic (4.7×10^{-7}). The total HI for non-carcinogenic effects is 1.2×10^{-3}, which is far below the 1.0 HI which indicates a potential hazard.

6.   References

(1)   United States Environmental Protection Agency, <u>Screening Procedures For Estimating the Air Quality Impact of Stationary Sources (Draft)</u>, EPA-450/4-88-010, August 1988.

(2)   United States Environmental Protection Agency, <u>Guideline on Air Quality Models (Revised)</u>, EPA-450/2-78-027, July 1986.

(3)   Auer, A.H., <u>Correlation of Land and Cover With Meteorological Anomalies</u>, Journal of Applied Meteorology, 17, 1978, pp. 636-643.

(4)   40 CFR 51, Stack Height Regulations: Final Rule, 1985.

(5)   United States Environmental Protection Agency, Office of Solid Waste, <u>Guidance on Metals and Hydrogen Chloride Controls for Hazardous Waste Incinerator (Draft)</u>, March 1989.

(6)   American Conference of Governmental and Industrial Hygienists, <u>Threshold Limit Values and Biological Exposure Indices for 1989-1990</u>,   1989.

(7)   United States Environmental Protection Agency, <u>Superfund Exposure Assessment Manual, OSWER Directive 9285.5-1</u>, EPA 540/1-88/001, 1988.

(8)   United States Environmental Protection Agency, <u>Exposure Factors Handbook,</u> EPA/600/8-89/043, 1989.

(9)   United States Environmental Protection Agency, <u>Health Effects Assessment Summary Tables</u>, OERR, 9200.6-303-(89-2), 1989.

SITE LOCATION MAP
SCRDI BLUFF ROAD SITE

LEGEND

▲ PROPOSED LOCATION OF
THERMAL DESORPTION
UNIT

QUADRANGLE LOCATION

KM.

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Table 1. SCRDL - Bluff Road Site ⬤ nic and Metal Emission Rates
and Associated Input Data

Thermal Desorption

Soil feed rate (lb/hr)	80,000
Organic destruction efficiency (%)	99.99%

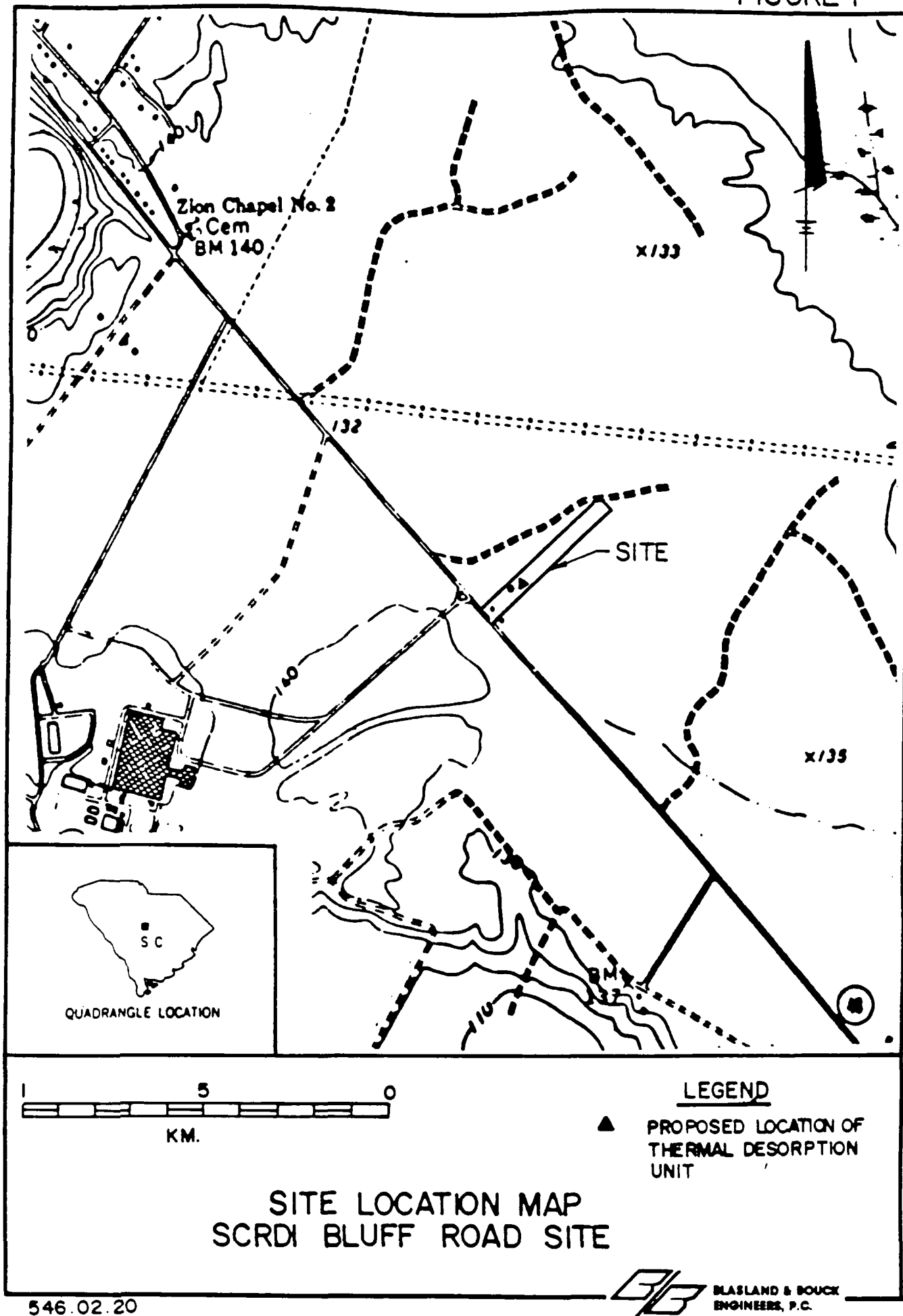| Classification	Chemical Name	Boiling Point (F)	Max Soil Organic Conc. (ppb)	Max Soil Metals Conc. (ppm)	Metals Partitioning Factor (a)	APC (b) Efficiency (c) (%)	Stack Emission Rates Organics (g/sec)	Stack Emission Rates Metals (g/sec)
Volatiles	ACETONE		160000.0				1.61E-04	0.00E+00
	CHLOROFORM		10000.0				1.01E-05	0.00E+00
	1,1,1,-TRICHLOROETHANE		14000.0				1.41E-05	0.00E+00
	METHYLENE CHLORIDE		39000.0				3.93E-05	0.00E+00
	CARBON DISULFIDE		2.0				2.02E-09	0.00E+00
	1,1-DICHLOROETHANE		390.0				3.93E-07	0.00E+00
	2-BUTANONE		89000.0				8.97E-05	0.00E+00
	TRICHLOROETHENE		44000.0				4.44E-05	0.00E+00
	1,1,2,2-TETRACHLOROETHENE		2300000.0				2.32E-03	0.00E+00
	ETHYLBENZENE		18000.0				1.81E-05	0.00E+00
	4-METHYL-2-PENTANONE		340.0				3.43E-07	0.00E+00
	TOLUENE		340000.0				3.43E-04	0.00E+00
	CHLOROBENZENE		23000.0				2.32E-05	0.00E+00
	TETRACHLOROETHENE		95000.0				9.58E-05	0.00E+00
	1,2-DICHLOROETHENE		45.0				4.54E-08	0.00E+00
	XYLENES		62000.0				6.25E-05	0.00E+00
	STYRENE		6.0				6.05E-09	0.00E+00
	VINYL CHLORIDE		24.0				2.42E-08	0.00E+00
	1,1-DICHLOROETHENE		240.0				2.42E-07	0.00E+00
	BENZENE		590.0				5.95E-07	0.00E+00
	1,2-DICHLOROETHANE		120.0				1.21E-07	0.00E+00
	CARBON TETRACHLORIDE		4100.0				4.13E-06	0.00E+00
	1,1,2-TRICHLOROETHANE		7.0				7.06E-09	0.00E+00

Table 1. SCRDI - Bluff Road S●●●rganic and Metal Emission Rates
and Associated Input Data

Thermal Desorption

Soil feed rate (lb/hr)   80,000
Organic destruction efficiency (%)   99.99%

Classification	Chemical Name	Boiling Point (F)	Max Soil Organic Conc. (ppb)	Max Soil Metals Conc. (ppm)	Metals Partitioning Factor (a)	APC (b) Efficiency (c) (%)	Stack Emission Rates Organics (g/sec)	Stack Emission Rates Metals (g/sec)
Semi-volatiles	BENZOIC ACID	480.0	110000.0				1.11E-04	0.00E+00
	N-BUTYL PHTHALATE	340.0	2200.0				2.22E-06	0.00E+00
	NAPHTHALENE	410.0	3900.0				3.93E-06	0.00E+00
	2-METHYLPHENOL		120000.0				1.21E-04	0.00E+00
	2-CHLOROPHENOL	347.0	2000000.0				2.02E-03	0.00E+00
	2,4,5-TRICHLOROPHENOL	485.0	810.0				8.16E-07	0.00E+00
	BENZYL ALCOHOL	403.0	330000.0				3.33E-04	0.00E+00
	4-METHYLPHENOL		14000.0				1.41E-05	0.00E+00
	PHENOL	358.0	6300000.0				6.35E-03	0.00E+00
	BIS(2EH)PHTHALATE		7600.0				7.66E-06	0.00E+00
	N-OCTYL PHTHALATE		44000.0				4.44E-05	0.00E+00
	HEXACHLOROBENZENE	612.0	7200.0				7.26E-06	0.00E+00
	ISOPHORONE	419.0	450.0				4.54E-07	0.00E+00
	2,4-DICHLOROPHENOL	410.0	130000.0				1.31E-04	0.00E+00
	DIETHYLPHTHALATE	561.0	1500.0				1.51E-06	0.00E+00
	NITROSODIPHENYLAMINE		820.0				8.27E-07	0.00E+00
	HEXACHLOROETHANE		1200.0				1.21E-06	0.00E+00
	2,4,6-TRICHLOROPHENOL		280.0				2.82E-07	0.00E+00
	NITROBENZENE		11000.0				1.11E-05	0.00E+00

Thermal Desorption

| Soil feed rate (lb/hr) | 80,000 |
| Organic destruction efficiency (%) | 99.99% |

Classification	Chemical Name	Boiling Point (F)	Max Soil Organic Conc. (ppb)	Max Soil Metals Conc. (ppm)	Metals Partitioning Factor (a)	APC (b) Efficiency (c) (%)	Stack Emission Rates Organics (g/sec)	Stack Emission Rates Metals (g/sec)
Metals	Antimony			6.0	0.05	90%	0.00E+00	3.02E-04
	Arsenic			8.2	1	90%	0.00E+00	8.27E-03
	Barium			190.0	0.05	95%	0.00E+00	4.79E-03
	Beryllium			1.3	0.05	95%	0.00E+00	3.28E-05
	Cadmium			4.0	1	90%	0.00E+00	4.03E-03
	Chromium			64.0	0.05	95%	0.00E+00	1.61E-03
	Lead			158.0	1	90%	0.00E+00	1.59E-01
	Mercury			6.6	1	50%	0.00E+00	3.33E-02
	Silver			5.0	0.05	95%	0.00E+00	1.26E-04
	Thallium			0.9	1	90%	0.00E+00	9.07E-04

(a) Metals partitioning factor at 600 F.

(b) Air Pollution Control (APC).

(c) APC metals removal efficiency for fabric filter and wet scrubber, from reference 1.

TABLE 2

DESIGN STACK PARAMETERS FOR
TREATMENT OF SOIL USING THERMAL DESORPTION

UTM Coordinates (km)		Stack Base Elevation	Stack Height	Stack Diameter	Exhaust Flow Rate	Exhaust Velocity	Exhaust Gas Exit Temp.
Easting	Northing	(m)	(m)	(m)	(ACFM)	(m/s)	(°K)
508.445	3749.375	41.76	18.29	1.067	28,000	14.78	344.3

TABLE 3

METEOROLOGICAL CONDITIONS USED FOR THE
PTPLU-2 SCREENING ANALYSIS

Stability Class	Wind Speed (m/s)
A	0.5, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0
B	0.5, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0
C	2.0, 2.5, 3.0, 4.0, 5.0, 7.0, 10.0, 12.0, 15.0
D	0.5, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.0, 10.0, 12.0, 15.0, 20.0
E	2.0, 2.5, 3.0, 4.0, 5.0
F	2.0, 2.5, 3.0, 4.0, 5.0

Note: The wind is assumed to be blowing directly from the source to the receptor.

TABLE 4

LOCATIONS OF DISCRETE FENCELINE MODELING RECEPTORS

UTM Coordinates (km)		Elevation	
Easting	Northing	Meters	Feet
508.340	3749.310	42.06	138
508.417	3749.374	42.06	138
508.494	3749.438	41.76	137
508.571	3749.502	41.76	137
508.648	3749.566	41.45	136
508.680	3749.593	41.45	136
508.703	3749.565	41.45	136
508.671	3749.538	41.45	136
508.594	3749.474	41.76	137
508.517	3749.410	41.76	137
508.440	3749.346	42.06	138
508.363	3749.282	42.06	138

TABLE 5

MAXIMUM PREDICTED
1-HOUR AND ANNUAL CONCENTRATIONS
FOR TREATMENT OF SOIL USING THERMAL DESORPTION

Contaminant	Maximum Concentration (ug/m^3)	
	1-Hour	Annual
Volatiles		
Acetone	3.69×10^{-3}	1.10×10^{-4}
Chloroform	2.31×10^{-4}	6.89×10^{-6}
1,1,1-Trichloroethane	3.23×10^{-4}	9.62×10^{-6}
Methylene Chloride	9.00×10^{-4}	2.68×10^{-5}
Carbon Disulfide	4.62×10^{-8}	1.38×10^{-9}
1,1-Dichloroethane	9.00×10^{-6}	2.68×10^{-7}
2-Butanone	2.05×10^{-3}	6.12×10^{-5}
Trichloroethene	1.02×10^{-3}	3.03×10^{-5}
1,1,2,2-Tetrachloroethane	5.31×10^{-2}	1.58×10^{-3}
Ethylbenzene	4.14×10^{-4}	1.23×10^{-5}
4-Methyl-2-Pentanone	7.85×10^{-6}	2.34×10^{-7}
Toluene	7.85×10^{-3}	2.34×10^{-4}
Chlorobenzene	5.31×10^{-4}	1.58×10^{-5}
Tetrachloroethene	2.19×10^{-3}	6.53×10^{-5}
1,2-Dichloroethene	1.04×10^{-6}	3.10×10^{-8}
Xylenes	1.43×10^{-3}	4.26×10^{-5}
Styrene	1.39×10^{-7}	4.26×10^{-9}
Vinyl Chloride	5.54×10^{-7}	1.65×10^{-8}
1,1-Dichloroethene	5.54×10^{-6}	1.65×10^{-7}
Benzene	1.36×10^{-5}	4.06×10^{-7}
1,2-Dichloroethane	2.77×10^{-6}	8.25×10^{-8}
Carbon Tetrachloride	9.45×10^{-5}	2.82×10^{-6}
1,1,2-Trichloroethane	1.62×10^{-7}	4.82×10^{-9}
Semivolatiles		
Benzoic Acid	2.54×10^{-3}	7.57×10^{-5}
N-Butyl Phthalate	5.08×10^{-5}	1.51×10^{-6}
Naphthalene	9.00×10^{-5}	2.68×10^{-6}
2-Methylphenol	2.77×10^{-3}	8.25×10^{-5}
2-Chlorophenol	4.62×10^{-2}	1.38×10^{-3}
2,4,5-Trichlorophenol	1.87×10^{-5}	5.57×10^{-7}
Benzyl Alcohol	7.62×10^{-3}	2.27×10^{-4}
4-Methylphenol	3.23×10^{-4}	9.62×10^{-6}
Phenol	1.45×10^{-1}	4.33×10^{-3}
Bis(2eh)Phthalate	1.75×10^{-4}	5.22×10^{-6}
N-Octyl Phthalate	1.02×10^{-3}	3.03×10^{-5}
Hexachlorobenzene	1.66×10^{-4}	4.95×10^{-6}
Isophorone	1.04×10^{-5}	3.10×10^{-7}
2,4-Dichlorophenol	3.00×10^{-3}	8.93×10^{-5}

TABLE 5 (Cont'd.)

MAXIMUM PREDICTED
1-HOUR AND ANNUAL CONCENTRATIONS
FOR TREATMENT OF SOIL USING THERMAL DESORPTION

Contaminant	Maximum Concentration (ug/m^3)	
	1-Hour	Annual
Semivolatiles (Cont'd.)		
Diethylphthalate	3.46×10^{-5}	1.03×10^{-6}
Nitrosodiphenylamine	1.89×10^{-5}	5.64×10^{-7}
Hexachloroethane	2.77×10^{-5}	8.25×10^{-7}
2,4,6-Trichlorophenol	6.46×10^{-6}	1.92×10^{-7}
Nitrobenzene	2.54×10^{-4}	7.57×10^{-6}
Metals		
Antimony	6.91×10^{-3}	2.06×10^{-4}
Arsenic	1.89×10^{-1}	5.64×10^{-3}
Barium	1.10×10^{-1}	3.27×10^{-3}
Beryllium	7.51×10^{-4}	2.24×10^{-5}
Cadmium	9.23×10^{-2}	2.75×10^{-3}
Chromium	3.69×10^{-2}	1.10×10^{-3}
Lead	3.64	1.08×10^{-1}
Mercury	7.62×10^{-1}	2.27×10^{-2}
Silver	2.88×10^{-3}	8.59×10^{-5}
Thallium	2.08×10^{-2}	6.19×10^{-4}

TABLE 6

THRESHOLD LIMIT VALUES
FOR THERMAL DESORPTION UNIT EMISSIONS

Contaminant	Maximum[1] 1-Hour Concentration (ug/m^3)	Threshold[2] Limit Values Time Weighted Averages (ug/m^3)
Volatiles		
Acetone	3.69×10^{-3}	1.78×10^{6}
Chloroform	2.31×10^{-4}	4.90×10^{4}
1,1,1-Trichloroethane	3.23×10^{-4}	1.91×10^{6}
Methylene Chloride	9.00×10^{-4}	1.74×10^{5}
Carbon Disulfide	4.62×10^{-8}	3.10×10^{4}
1,1-Dichloroethane	9.00×10^{-6}	8.10×10^{5}
2-Butanone	2.05×10^{-3}	5.90×10^{5}
Trichloroethene	1.02×10^{-3}	2.69×10^{5}
1,1,2,2-Tetrachloroethane	5.31×10^{-2}	6.90×10^{3}
Ethylbenzene	4.14×10^{-4}	4.34×10^{5}
4-Methyl-2-Pentanone	7.85×10^{-6}	
Toluene	7.85×10^{-3}	3.77×10^{5}
Chlorobenzene	5.31×10^{-4}	4.60×10^{4}
Tetrachloroethene	2.19×10^{-3}	3.39×10^{5}
1,2-Dichloroethene	1.04×10^{-6}	3.47×10^{5}
Xylenes	1.43×10^{-3}	4.34×10^{5}
Styrene	1.39×10^{-7}	2.13×10^{5}
Vinyl Chloride	5.54×10^{-7}	1.30×10^{4}
1,1-Dichloroethene	5.54×10^{-6}	2.00×10^{4}
Benzene	1.36×10^{-5}	3.20×10^{4}
1,2-Dichloroethane	2.77×10^{-6}	4.00×10^{4}
Carbon Tetrachloride	9.45×10^{-5}	3.10×10^{4}
1,1,2-Trichloroethane	1.62×10^{-7}	5.50×10^{4}
Semivolatiles		
Benzoic Acid	2.54×10^{-3}	1.90×10^{4}
N-Butyl Phthalate	5.08×10^{-5}	
Naphthalene	9.00×10^{-5}	5.20×10^{4}
2-Methylphenol	2.77×10^{-3}	2.20×10^{4}
2-Chlorophenol	4.62×10^{-2}	
2,4,5-Trichlorophenol	1.87×10^{-5}	
Benzyl Alcohol	7.62×10^{-3}	
4-Methylphenol	3.23×10^{-4}	2.20×10^{4}
Phenol	1.45×10^{-1}	1.90×10^{4}

TABLE 6 (Cont'd.)

THRESHOLD LIMIT VALUES
FOR THERMAL DESORPTION UNIT EMISSIONS

Contaminant	Maximum[1] 1-Hour Concentration (ug/m^3)	Threshold[2] Limit Values Time Weighted Averages (ug/m^3)
Semivolatiles (Cont'd.)		
Bis(2eh)Phthalate	1.75×10^{-4}	5.00×10^3
N-Octyl Phthalate	1.02×10^{-3}	
Hexachlorobenzene	1.66×10^{-4}	
Isophorone	1.04×10^{-5}	2.80×10^4
2,4-Dichlorophenol	3.00×10^{-3}	
Diethylphthalate	3.46×10^{-5}	5.00×10^3
Nitrosodiphenylamine	1.89×10^{-5}	
Hexachloroethane	2.77×10^{-5}	9.70×10^3
2,4,6-Trichlorophenol	6.46×10^{-6}	
Nitrobenzene	2.54×10^{-4}	5.00×10^3
Metals		
Antimony	6.91×10^{-3}	5.00×10^2
Arsenic	1.89×10^{-1}	2.00×10^2
Barium	1.10×10^{-1}	5.00×10^2
Beryllium	7.51×10^{-4}	2.00
Cadmium	9.23×10^{-2}	1.00×10^1
Chromium	3.69×10^{-2}	5.00×10^2
Lead	3.64	1.50×10^2
Mercury	7.62×10^{-1}	1.00×10^1
Silver	2.88×10^{-3}	1.00×10^2
Thallium	2.08×10^{-2}	1.00×10^2

Notes:

1 Values derived from air modeling described previously.

2 TLV-TWA represents an exposure for an 8-hour day/40-hour workweek, which results in no adverse effects.[6]

TABLE 7

EXPOSURE SCENARIO FOR WORKER
INHALATION OF AIRBORNE CONTAMINANTS FROM
THERMAL DESORPTION UNIT EMISSIONS

Receptors:	On-site workers
Adult or Child:	Adult
Male/Female:	Male
Activity Level:	Moderate
Frequency of Event:	100 days/year
Duration of Event:	8 hours/day
Inhalation Rate:	2.8 m^3/hour [7]
Weight:	70 kg [8]

Potential Exposure Pathways Considered Significant:

Inhalation of Ambient Air

Compounds: All site-specific chemicals.

Data Sets: Maximum annual concentrations predicted from modeling incinerator emissions.

TABLE   8

EXPOSURE SCENARIO FOR 6-YEAR OLD CHILD AT OFF-SITE AREA
INHALATION OF AIRBORNE CONTAMINANTS FROM
THERMAL DESORPTION UNIT EMISSIONS

Receptors:	6-year old child
Adult or Child:	Child
Male/Female:	Male
Activity Level:	Moderate activity
Frequency of Event:	100 days/year
Duration of Event:	4 hours/day
Inhalation Rate:	2.1 m^3/hour [7]
Weight:	19.7 kg [8]

Potential Exposure Pathways Considered Significant:

Inhalation of Ambient Air

Compounds: All site-specific chemicals.

Data Sets: Maximum   annual   concentrations
                                        predicted from modeling incinerator
                                        emissions.

TABLE 9

RISK CALCULATIONS FOR WORKERS
INHALATION OF AIRBORNE CONTAMINANTS FROM
THERMAL DESORPTION UNIT EMISSIONS

Chemical	Maximum Annual Air Concent. (ug/m³)	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF (mg/kg/day)$^{-1}$	Inhalation AIC/RID (mg/kg/day)	Risk	Hazard Index
Volatiles						
Acetone	1.10×10^{-4}	1.4×10^{-10}				
Chloroform	6.89×10^{-6}	8.6×10^{-12}	8.1×10^{-2}		7.0×10^{-13}	
1,1,1-Trichloroethane	9.62×10^{-6}	1.2×10^{-11}		3.0×10^{-1}		4.0×10^{-11}
Methylene Chloride	2.68×10^{-5}	3.4×10^{-11}	1.4×10^{-2}		4.8×10^{-13}	
Carbon Disulfide	1.38×10^{-9}	1.7×10^{-15}				
1,1-Dichloroethane	2.68×10^{-7}	3.4×10^{-13}		1.0×10^{-1}		3.4×10^{-12}
2-Butanone	6.12×10^{-5}	7.6×10^{-11}				
Trichloroethene	3.03×10^{-5}	3.8×10^{-11}	1.3×10^{-2}		4.9×10^{-13}	
1,1,2,2-Tetrachloroethane	1.58×10^{-3}	2.0×10^{-9}	2.0×10^{-1}		4.0×10^{-10}	
Ethylbenzene	1.23×10^{-5}	1.5×10^{-11}				
4-Methyl-2-Pentanone	2.34×10^{-7}	2.9×10^{-13}				
Toluene	2.34×10^{-4}	2.9×10^{-10}		1.0		2.9×10^{-10}
Chlorobenzene	1.58×10^{-5}	2.0×10^{-11}		5.0×10^{-3}		4.0×10^{-9}
Tetrachloroethene	6.53×10^{-5}	8.2×10^{-11}	3.3×10^{-3}		2.7×10^{-13}	
1,2-Dichloroethene	3.10×10^{-8}	3.9×10^{-14}				
Xylenes	4.26×10^{-5}	5.3×10^{-11}		4.0×10^{-1}		1.3×10^{-10}
Styrene	4.26×10^{-9}	5.3×10^{-15}		1.0×10^{-2}		5.3×10^{-13}
Vinyl Chloride	1.65×10^{-8}	2.1×10^{-14}	2.9×10^{-1}		6.1×10^{-15}	
1,1-Dichloroethene	1.65×10^{-7}	2.1×10^{-13}	1.2		2.5×10^{-13}	
Benzene	4.06×10^{-7}	5.1×10^{-13}	2.9×10^{-2}		1.5×10^{-14}	
1,2-Dichloroethane	8.25×10^{-8}	1.0×10^{-13}	9.1×10^{-2}		9.4×10^{-15}	
Carbon Tetrachloride	2.82×10^{-6}	3.5×10^{-12}	1.3×10^{-1}		4.6×10^{-13}	
1,1,2-Trichloroethane	4.82×10^{-9}	6.0×10^{-15}	5.7×10^{-2}		3.4×10^{-16}	

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TABLE 9 (Cont'd.)

RISK CALCULATIONS FOR WORKERS
INHALATION OF AIRBORNE CONTAMINANTS FROM
THERMAL DESORPTION UNIT EMISSIONS

Chemical	Maximum Annual Air Concent. (ug/m³)	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF (mg/kg/day)⁻¹	Inhalation AIC/RID (mg/kg/day)	Risk	Hazard Index
Semivolatiles						
Benzoic Acid	7.57×10^{-5}	9.5×10^{-11}				
N-Butyl Phthalate	1.51×10^{-6}	3.8×10^{-11}				
Naphthalene	2.68×10^{-6}	3.4×10^{-12}				
2-Methylphenol	8.25×10^{-5}	1.0×10^{-10}				
2-Chlorophenol	1.38×10^{-3}	1.7×10^{-9}				
2,4,5-Trichlorophenol	5.57×10^{-7}	7.0×10^{-13}				
Benzyl Alcohol	2.27×10^{-4}	2.8×10^{-10}				
4-Methylphenol	9.62×10^{-6}	1.2×10^{-11}				
Phenol	4.33×10^{-3}	5.4×10^{-9}				
Bis(2eh)phthalate	5.22×10^{-6}	6.5×10^{-12}				
N-Octyl phthalate	3.03×10^{-5}	3.8×10^{-11}				
Hexachlorobenzene	4.95×10^{-6}	6.2×10^{-12}	1.7		1.1×10^{-11}	
Isophorone	3.10×10^{-7}	3.9×10^{-13}				
2,4-Dichlorophenol	8.93×10^{-5}	1.1×10^{-10}				
Diethylphthalate	1.03×10^{-6}	1.3×10^{-12}				
Nitrosodiphenylamine	5.64×10^{-7}	7.1×10^{-13}				
Hexachloroethane	8.25×10^{-7}	1.0×10^{-12}				
2,4,6-Trichlorophenol	1.92×10^{-7}	2.4×10^{-13}	2.0×10^{-2}		4.8×10^{-15}	
Nitrobenzene	7.57×10^{-6}	9.5×10^{-12}		6.0×10^{-4}		1.6×10^{-8}
Metals						
Antimony	2.06×10^{-4}	2.6×10^{-15}				
Arsenic	5.64×10^{-3}	7.1×10^{-9}	5.0×10^{1}		3.5×10^{-7}	

TABLE 9   (Cont'd.)

RISK CALCULATIONS FOR WORKERS
INHALATION OF AIRBORNE CONTAMINANTS FROM
THERMAL DESORPTION UNIT EMISSIONS

Chemical	Maximum Annual Air Concent. $(\mu g/m^3)$	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RID (mg/kg/day)	Risk	Hazard Index
Metals (Cont'd.)						
Barium	3.27×10^{-3}	4.1×10^{-9}		1.0×10^{-4}		4.1×10^{-5}
Beryllium	2.24×10^{-5}	2.8×10^{-11}	8.4		2.3×10^{-10}	
Cadmium	2.75×10^{-3}	3.4×10^{-9}	6.1		2.1×10^{-8}	
Chromium VI	1.10×10^{-3}	1.4×10^{-9}	4.1×10^{1}		5.6×10^{-8}	
Chromium III	1.10×10^{-3}	1.4×10^{-9}		5.1×10^{-3}		2.7×10^{-7}
Lead (inorganic)	1.08×10^{-1}	1.4×10^{-7}		4.3×10^{-4}		3.2×10^{-4}
Mercury (inorganic)	2.27×10^{-2}	2.8×10^{-8}		5.1×10^{-5}		5.6×10^{-4}
Silver	8.59×10^{-5}	1.1×10^{-10}				
Thallium	6.19×10^{-4}	7.7×10^{-10}				
				TOTAL	4.3×10^{-7}	9.1×10^{-4}

TABLE 10

RISK CALCULATIONS FOR 6-YEAR OLD CHILD
INHALATION OF AIRBORNE CONTAMINANTS FROM
THERMAL DESORPTION UNIT EMISSIONS

Chemical	Maximum Annual Air Concent. (ug/m^3)	Inhalation Exposure Dosage $(mg/kg/day)$	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RfD $(mg/kg/day)$	Risk	Hazard Index
Volatiles						
Acetone	1.10×10^{-4}	1.8×10^{-10}				
Chloroform	6.89×10^{-6}	1.1×10^{-11}	8.1×10^{-2}		9.3×10^{-13}	
1,1,1-Trichloroethane	9.62×10^{-6}	1.6×10^{-11}		3.0×10^{-1}		5.3×10^{-11}
Methylene Chloride	2.68×10^{-5}	4.5×10^{-11}	1.4×10^{-2}		6.3×10^{-13}	
Carbon Disulfide	1.38×10^{-9}	2.3×10^{-15}				
1,1-Dichloroethane	2.68×10^{-7}	4.5×10^{-13}		1.0×10^{-1}		4.5×10^{-12}
2-Butanone	6.12×10^{-5}	1.0×10^{-10}				
Trichloroethene	3.03×10^{-5}	5.0×10^{-11}	1.3×10^{-2}		6.6×10^{-13}	
1,1,2,2-Tetrachloroethane	1.58×10^{-3}	2.6×10^{-9}	2.0×10^{-1}		5.3×10^{-10}	
Ethylbenzene	1.23×10^{-5}	2.1×10^{-11}				
4-Methyl-2-Pentanone	2.34×10^{-7}	3.9×10^{-13}				
Toluene	2.34×10^{-4}	3.9×10^{-10}		1.0		3.9×10^{-10}
Chlorobenzene	1.58×10^{-5}	2.6×10^{-11}		5.0×10^{-3}		5.3×10^{-9}
Tetrachloroethene	6.53×10^{-5}	1.1×10^{-10}	3.3×10^{-3}		3.6×10^{-13}	
1,2-Dichloroethene	3.10×10^{-8}	5.2×10^{-14}				
Xylenes	4.26×10^{-5}	7.1×10^{-11}		4.0×10^{-1}		1.8×10^{-10}
Styrene	4.26×10^{-9}	7.1×10^{-15}		1.0×10^{-2}		7.1×10^{-13}
Vinyl Chloride	1.65×10^{-8}	2.7×10^{-14}	2.9×10^{-1}		8.1×10^{-15}	
1,1-Dichloroethene	1.65×10^{-7}	2.7×10^{-13}	1.2		3.3×10^{-13}	
Benzene	4.06×10^{-7}	6.8×10^{-13}	2.9×10^{-2}		2.0×10^{-14}	
1,2-Dichloroethane	8.25×10^{-8}	1.4×10^{-13}	9.1×10^{-2}		1.3×10^{-14}	
Carbon Tetrachloride	2.82×10^{-6}	4.7×10^{-12}	1.3×10^{-1}		6.1×10^{-13}	
1,1,2-Trichloroethane	4.82×10^{-9}	8.0×10^{-15}	5.7×10^{-2}		4.6×10^{-16}	

TABLE 10   (Cont'd.)

RISK CALCULATIONS FOR 6-YEAR OLD CHILD
INHALATION OF AIRBORNE CONTAMINANTS FROM
THERMAL DESORPTION UNIT EMISSIONS

Chemical	Maximum Annual Air Concent. $(\mu g/m^3)$	Inhalation Exposure Dosage (mg/kg/day)	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RfD (mg/kg/day)	Risk	Hazard Index
Semivolatiles						
Benzoic Acid	7.57×10^{-5}	1.3×10^{-10}				
N-Butyl Phthalate	1.51×10^{-6}	5.0×10^{-11}				
Naphthalene	2.68×10^{-6}	4.5×10^{-12}				
2-Methylphenol	8.25×10^{-5}	1.4×10^{-10}				
2-Chlorophenol	1.38×10^{-3}	2.3×10^{-9}				
2,4,5-Trichlorophenol	5.57×10^{-7}	9.3×10^{-13}				
Benzyl Alcohol	2.27×10^{-4}	3.8×10^{-10}				
4-Methylphenol	9.62×10^{-6}	1.6×10^{-11}				
Phenol	4.33×10^{-3}	7.2×10^{-9}				
Bis(2eh)phthalate	5.22×10^{-6}	8.7×10^{-12}				
N-Octyl phthalate	3.03×10^{-5}	5.0×10^{-11}				
Hexachlorobenzene	4.95×10^{-6}	8.2×10^{-12}	1.7		1.4×10^{-11}	
Isophorone	3.10×10^{-7}	5.2×10^{-13}				
2,4-Dichlorophenol	8.93×10^{-5}	1.5×10^{-10}				
Diethylphthalate	1.03×10^{-6}	1.7×10^{-12}				
Nitrosodiphenylamine	5.64×10^{-7}	9.4×10^{-13}				
Hexachloroethane	8.25×10^{-7}	1.4×10^{-12}				
2,4,6-Trichlorophenol	1.92×10^{-7}	3.2×10^{-13}	2.0×10^{-2}		6.4×10^{-15}	
Nitrobenzene	7.57×10^{-6}	1.3×10^{-11}		6.0×10^{-4}		2.1×10^{-8}
Metals						
Antimony	2.06×10^{-4}	3.4×10^{-15}				
Arsenic	5.64×10^{-3}	9.4×10^{-9}	5.0×10^{1}		4.7×10^{-7}	

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TABLE 10 (Cont'd.)

RISK CALCULATIONS FOR 6-YEAR OLD CHILD
INHALATION OF AIRBORNE CONTAMINANTS FROM
THERMAL DESORPTION UNIT EMISSIONS

Chemical	Maximum Annual Air Concent. (ug/m^3)	Inhalation Exposure Dosage $(mg/kg/day)$	Inhalation CPF $(mg/kg/day)^{-1}$	Inhalation AIC/RID $(mg/kg/day)$	Risk	Hazard Index
Metals (Cont'd.)						
Barium	3.27×10^{-3}	5.4×10^{-9}		1.0×10^{-4}		5.4×10^{-5}
Beryllium	2.24×10^{-5}	3.7×10^{-11}	8.4		3.1×10^{-10}	
Cadmium	2.75×10^{-3}	4.6×10^{-9}	6.1		2.8×10^{-8}	
Chromium VI	1.10×10^{-3}	1.8×10^{-9}	4.1×10^{1}		7.5×10^{-8}	
Chromium III	1.10×10^{-3}	1.8×10^{-9}		5.1×10^{-3}		3.6×10^{-7}
Lead (inorganic)	1.08×10^{-1}	1.8×10^{-7}		4.3×10^{-4}		4.2×10^{-4}
Mercury (inorganic)	2.27×10^{-2}	3.8×10^{-8}		5.1×10^{-5}		7.4×10^{-4}
Silver	8.59×10^{-5}	1.4×10^{-10}				
Thallium	6.19×10^{-4}	1.0×10^{-9}				
				TOTAL	5.7×10^{-7}	1.2×10^{-3}